

BEFORE THE
NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C.

- - - - -x
In the matter of the investigation :
of the accident involving :
Trans World Airlines, Inc. :
Flight 800, B-747-131, N93119, :
8 miles south East Moriches, :
New York on July 17, 1996 :
- - - - -X

Baltimore Convention Center
Halls A and B
One West Pratt Street
Baltimore, Maryland 21201-2499

Friday, December 12, 1997

The above-entitled matter reconvened for
hearing pursuant to notice, at 9:00 a.m.

APPEARANCES :

Board of Inquiry:

Honorable Jim Hall Chairman	Member NTSB
Dr. Bernard Loeb	Director, Office of Aviation Safety
Dr. Vernon Ellingstad	Director, Office of Research and Engineering
Mr. Barry Sweedler	Director, Office of Safety Recommendations and Accomplishments
Mr. Dan Campbell	General Counsel

Technical Panel:

Thomas Haueter	Chief, Major Investigations Division
Al Dickinson	Investigator-in-Charge, Operations

Also Present:

Debra Eckrote
 Norman Wiemeyer
 Malcolm Brenner
 James Wildey
 John Clark
 Frank Hilldrup
 David Mayer
 But Simon
 Henry Hughes
 George Anderson
 Doug Wiegman
 Mitchell Garber
 Merritt Birky
 Dan Bower
 Dennis Crider
 Robert Swaim
 Charles Pereira
 Deepak Joshi
 Larry Jackson

Parties:

Lyle K. Streeter	Air Safety Investigator, Department of Transportation, FAA
Captain Jerome Rekart	Chief Accident Investigator, Air Line Pilots Association
Captain Robert Young	Director of Flight Operations Safety, Trans World Airlines
J. Dennie Rodrigues	Senior Air Safety Investigator, Boeing Commercial Airplane Group
Fred Liddell	Chief Investigator, International Association of Machinists and Aerospace Workers
Hal Thomas	Technical Engineer, Honeywell
Raymond Boushie	President, Hydro-Aire

I N D E X

Opening Statements: Page

None.

WITNESS

Tom McSweeney	10
Ivor Thomas	41
Captain Steve Green	64

EXH I B I T S

EXHIBIT NUMBER	DESCRIPTION
----------------	-------------

None.

Closing Statements: Page

None.

PRO C E E D I N G S

(Time Noted: 8:55)

CHAIRMAN HALL: We will reconvene this hearing of the National Transportation Safety Board that is being held in connection with the investigation of an aircraft accident involving Trans World Airlines Flight 800, a Boeing 747-131 that occurred eight miles south of East Moriches, New York July 17th, 1996. Information on this hearing and the proceedings can be obtained off the Internet at www.nts.gov.

I would like to welcome the panel back this morning. I would like to welcome an addition to the panel, Dr. Shepherd who has appeared with us before and has been previously sworn from Cal. Tech.

Before we turn it over to the Technical Panel -- Dr. Ball, you moved this morning. I see you are down there. I have found this letter I was so frantically searching for yesterday, and to my able staff I say thank you. We have received thousands of pieces of correspondence, and the one I wanted to bring to your attention was from -- was written to Senator McCain by Peter Carnivell (sic), a Research Engineer in Sonoita, Arizona.

He writes, "Dear Senator McCain, with the death of some 230 people on TWA Flight 800, I feel an

1 obligation to help solve a very serious defect in our
2 commercial airline fleet. During the Vietnam War I
3 equipped all military combat air craft with reticulate
4 polyurethane foam in the fuel tanks. The aircraft you
5 flew was so equipped."

6 We are not sure of that, so whether it was a
7 maybe or not -- but, "the material accomplished two
8 things . It acted as an infinite baffle which kept the
9 fuel in a liquid state in a crash, thus reducing the
10 fire hazard, and it also quenched any fire that would
11 start from any ignition source of an empty fuel cell."

12 "This material was tested by the FAA in 1965.
13 The FAA test substantiated the Air Force test findings
14 that the foam-filled tanks substantially reduced the
15 risk of fire and/or explosion of empty fuel tanks
16 during crash landings and from any ignition source in
17 the air. Even incendiary rounds were unable to ignite
18 these tanks."

19 "FAA decided not to use this technology due
20 to their development program for solidified fuels. In
21 the middle 80's they finally tested their solidified
22 fuels with disastrous results at Mojave. I submit that
23 for thirty years there has been a solution that could
24 have saved Flight 800 and possibly saved many more
25 lives during crash landings."

1 "The reticulate polyurethane foam reduced the
2 available fuel by about two percent and is completely
3 passive. After twenty years of operations at F-4's,
4 McDonnell Douglas found no deterioration of the foam
5 material in the tanks. Also, there has been no
6 microbiological growth in the tanks due to the foam."

7 "I firmly believe that this material should
8 be used in all commercial aircraft. The cost is
9 minimal and the benefits outweigh the two percent loss
10 in fuel. Fuel system purging can be accomplished in
11 many different ways, nitrogen being the most common
12 method, but no other system is completely passive,
13 which is still the biggest attraction of the foam."

14 "Additional information can be obtained on
15 the Air Force project from the Aeronautical Systems
16 Division. Wright Patterson Air Force Base in Dayton,
17 Ohio. The contract numbers which pertain to this
18 project were Air Force 33-615-54-24, Air Force 33-615-
19 12-17, Air Force 33-615-32-77 and Air Force 33-617-38-
20 80."

21 "I was project manager for this program and
22 would be willing to assist the implementation of this
23 project."

24 Senator McCain sent this letter over to me
25 and we responded to Mr. Carnivelle on July 8th, and

1 which we had a discussion that I won't go into because
2 you covered a lot of the material about the -- about
3 the use of this foam, but we did -- I did close the
4 letter by saying, "We appreciate your bringing this
5 subject to our renewed attention. Please be assured
6 during our continuing investigation of the TWA Flight
7 800 accident we will consider this issue further,
8 including discussing with the FAA further research into
9 the use of reticulate polyurethane foam in fuel tanks."

10 That letter got my specific attention because
11 like Senator McCain, I am a Vietnam Era Veteran,
12 although I served in the Army, and I was very aware of
13 Senator McCain's excellent service to our country and
14 what he did, and when somebody talked about it being in
15 his airplane, I -- that got my special attention.

16 So, maybe as we get into the rest of the
17 panel today we can discuss it a little more, but you
18 think -- the Navy did not have that in their airplanes,
19 right?

20 MR. BALL: It has been my experience that the
21 Navy did not use foam in their aircraft in Southeast
22 Asia primarily because they flew JP-5 which is a
23 significantly less volatile fuel, and therefore they
24 didn't feel they had the problem that the Air Force had
25 with the JP-4.

1 The Air Force developed this orange foam and
2 put it into many of their aircraft, literally tacking
3 it into the aircraft, because at that time we did not
4 fully understand how it worked and we wanted to make
5 sure it was effective. We know it saved quite a few
6 aircraft in Southeast Asia.

7 CHAIRMAN HALL: Well, I don't guess -- now,
8 who is the gentleman from Wright-Patman? Yes, sir?
9 Mr. Lauzze, do you know this gentleman?

10 MR. LAUZZE: No, I do not know him, sir.

11 CHAIRMAN HALL: Okay, well, you might want to
12 check him out. He says he is still willing to help.

13 MR. LAUZZE: We will follow up on it, sir.

14 CHAIRMAN HALL: He sounds very knowledgeable.
15 Well, I will turn it back over now to the panel and,
16 Mr. Anderson, if you want to continue with the
17 conversations .

18 MR. ANDERSON: Thank you, Mr. Chairman. Good
19 morning, Mr. McSweeney.

20 MR. MCSWEENEY: Good morning.

21 Whereupon,

22 TOM MCSWEENEY, GREGORY DUNN, BILL CROW,

23 GEORGE SLENSKI, KEN CRAYCRAFT, IVOR THOMAS,

24 ALEX TAYLOR AND ROBERT VANNOY

25 were re-called as witnesses by and on behalf of the

1 NTSB, and, after having been previously duly sworn,
2 were examined and testified further as follows.
3

1 DIRECT EXAMINATION

2 BY MR. ANDERSON:

3 Q We invited you to this panel today to discuss
4 the impact that the military survivability techniques
5 that we have discussed in the last session might -- and
6 also existing fuel protection designs -- might have on
7 the FAA's view of the regulatory problem concerning
8 fuel tank safety.

9 In view of what we heard yesterday from Dr.
10 Ball and the testing people with the DOD, which one of
11 these concepts or designs, preferably ones that are all
12 ready in use by the military, would you say would be
13 most applicable and be most quickly adapted into a
14 commercial environment?

15 A Well, I think it would be a mistake to make
16 that decision here today. If you consider the fuel
17 triangle and the three components, the FAA's program
18 deals with looking at the fuel, the ignition and the
19 oxidizer, in this case oxygen.

20 I think it would be premature to say anything
21 other than everything is on the table. Until all are
22 weighed against each other, I think it is premature to
23 make any decisions about which are more feasible in
24 civil aviation than any others.

25 Q Do I understand you to say, sir, that this

1 process of evaluation of these systems is just
2 beginning?

3 A Oh, absolutely not. I mean, the FAA did in
4 fact look at nitrogen and inerting years ago. We have
5 been looking at everything dealing with the fuel
6 triangle since the accident.

7 One of the greatest myths is that we have
8 only been concerned about ignition sources, and that is
9 in fact a myth because that has not been our sole
10 approach since the accident.

11 Q Thank you very much. My point here --
12 perhaps I should restate the question -- is that we
13 have a series of technologies, we have provided a
14 tutorial, if you will, on the theoretical
15 underpinnings .

16 It would seem reasonable that some of these
17 technologies would have a shorter past development, and
18 given that the FAA has been studying this and my
19 records show here since at least 1971, that there would
20 be some engineering data on the part of the FAA that
21 would relate to this question and perhaps could be
22 shared with the public.

23 A If I may, I think your statement that we have
24 been studying it from '71 is really only partially
25 correct. We did study it in '71 and we did make a

1 decision, and the decision was made in the 70's. What
2 is true is that we haven't studied it since, until this
3 accident.

4 But, I don't want to leave the impression
5 that the FAA has been studying something for the last
6 twenty-five years.

7 Q What is your opinion of the -- we have been
8 discussing the foam technique for inerting or
9 preventing catastrophic explosion in fuel tanks. What
10 is your opinion of that technology at this point, sir?

11 DR. LOEB: Before you answer that, let -- I
12 would just like to ask a question, Mr. McSweeney. Why
13 is it that given that the fuel approach that you took
14 failed, why is it that you did not go back and take a
15 look at other options after the success of the early
16 1970 foam work?

17 WITNESS MCSWEENEY: The tests that I think
18 you are referring to is anti-misting kerosene, and that
19 was --

20 DR. LOEB: That is correct.

21 WITNESS MCSWEENEY: That was the test in the
22 desert. That test showed that the benefits that people
23 expected to have gotten from anti-misting kerosene and
24 the benefits before that time were seen in the
25 laboratory just did not present themselves in full

1 scale testing.

2 An interesting piece of information is a very
3 similar accident to that test in the desert occurred
4 one month after, and that was the Manchester accident
5 in which hot fuel came out of the wing and impinged on
6 an engine that was very hot, just like what happened in
7 that test in the desert.

8 That whole effort, though, was at post-crash
9 fires. I think that is important for everybody to
10 understand. The FAA at that time was looking at post-
11 crash fires and did, in fact, come to conclusions that
12 the anti-misting kerosene was not the way to go.

13 so, it took a different path, and it has
14 completed that path, and that path consists of
15 hardening the interior for fire entry into the cabin,
16 and that includes side wall ceiling panel flammability,
17 low level lighting, lavatory smoke detectors, et
18 cetera, et cetera.

19 DR. LOEB: All right, and I do recognize that
20 that was directed solely or primarily at post-crash
21 fire. However, the foam would be helpful in both post-
22 crash fire and helpful to prevent explosions of the
23 tank.

24 The early work indicated that the foam had
25 promise, at least, great promise in helping in both

1 directions. When the test in the Mojave failed, why
2 did you not go back and take a look at the foam as
3 another possibility. Incidentally, we have had post-
4 crash fires in accidents involving transport aircraft
5 since then.

6 WITNESS MCSWEENEY: Well, I would not deny
7 that statistic. The success, though, has been much
8 greater than it was before the 70's and 80's.

9 DR. LOEB: Yeah, I would agree.

10 WITNESS MCSWEENEY: The lives lost have gone
11 done significantly.

12 DR. LOEB: Yeah, I will agree with that. I
13 am just asking why you didn't go back and take a second
14 look. I mean, it may have been - there may have been
15 some factors that we need to know about here that were
16 involved in why you didn't; weight, or the penalties,
17 or --

18 WITNESS MCSWEENEY: At the -- well, I wasn't
19 in the decision-making at the time, so I can't be
20 exact, but my recollection of reading the material was
21 that we believed it was not a safety improvement that
22 mandated -- or, warranted that kind of action at the
23 time, because we were focusing on post-crash fires.

24 DR. LOEB: Is the FAA now looking at foam as
25 a potential source for both remediating fuel

1 explosions, fuel air explosions in the tank, and post-
2 crash fire?

3 WITNESS MCSWEENEY: We are looking at all
4 three elements of the fuel triangle -- the fire
5 triangle as possible solutions to explosions in fuel
6 tanks.

7 DR. LOEB: All right, but specifically --

8 WITNESS MCSWEENEY: And everything is on the
9 table.

10 DR. LOEB: Specifically, are you looking at
11 foam right now?

12 WITNESS MCSWEENEY: Yes.

13 DR. LOEB: Are there studies underway, and
14 can you help us out by telling us what you are doing in
15 that --

16 WITNESS MCSWEENEY: I don't personally know
17 of any studies. I guess first of all I would ask what
18 you mean by a study. We certainly are looking at what
19 has been done. We are working with the military in
20 trying to capture their experience and, as I said,
21 everything is on the table.

22 CHAIRMAN HALL: Was this letter correct? Was
23 there something done in 1965?

24 WITNESS MCSWEENEY: Mr. Chairman, I am really
25 not familiar with the letter.

1 CHAIRMAN HALL: I know that goes back a long
2 time, Mr. McSweeney.

3 WITNESS MCSWEENEY: So, I really hate to
4 comment on something I don't really have any knowledge
5 of.

6 CHAIRMAN HALL: Okay, I would appreciate it
7 if there was a test for -- in 1965 of this material,
8 that it could be provided for the record.

9 WITNESS MCSWEENEY: We will be glad to do
10 that.

11 CHAIRMAN HALL: Mr. Anderson?

12 BY MR. ANDERSON: (Resuming.)

13 Q Mr. McSweeney, following along here, I think
14 the foam is a good example of a technology that, of
15 course, deserves attention. But, I guess what we are
16 interested in is how the FAA is going to evaluate this,
17 what type of resources will be used and what the total
18 role will be of the FAA.

19 For instance, will your research facilities
20 be actually conducting tests, will you contract this
21 out? Just how would this program proceed, and could
22 you give us some idea of time that is involved?

23 A Well, it is really a multi-faceted effort.
24 We have a lot of expertise in fires, we have a lot of
25 expertise in fuels at the Technical Center. They have

1 been involved in the issues all along. They are
2 involved in the present effort.

3 We have several folks in Seattle working, in
4 effect, full time dealing with the possible solutions
5 to explosions in the fuel tank.

6 CHAIRMAN HALL: Mr. McSweeney, that leads me
7 to ask the question why, with all the expertise the FAA
8 has, was the decision made to have this studied by an
9 ARAC group for six months, which was Ms. Garvey's
10 response to the Chairman on December 3rd in regard to
11 our recommendations.

12 WITNESS MCSWEENEY: I was --

13 CHAIRMAN HALL: Do you know what the budget
14 is in Atlantic City, the fire --

15 WITNESS MCSWEENEY: Not off the top of my
16 head, no. No. I was about to get to that very point
17 in my answer. In the letter from Administrator Garvey,
18 it makes the clear point that the FAA has decided it is
19 going to do something.

20 That is not -- ARAC has not been asked to
21 study something. ARAC has been given -- is going to be
22 given the specific charter to develop specific
23 solutions, as everybody on ARAC sees them, of how to
24 deal with minimizing or eliminating explosive mixtures
25 in fuel tanks.

1 What we will -- are expecting to get at the
2 six month period is specific technical answers and
3 solutions .

4 CHAIRMAN HALL: Well, let me ask one other
5 question, then -- and let me say again, sometimes I
6 don't think the public appreciates some of the
7 regulatory processes that are in place at the FAA that
8 require you all to - and are there obviously to be
9 sure hasty decisions and wrong decisions aren't made
10 which everybody, I think, acknowledges and appreciates.

11 But, it says "after the notice of the new
12 task assignment goes to the Federal Register." Could
13 you give us a date this morning on when that will go to
14 the Federal Register?

15 WITNESS MCSWEENEY: We have promised that
16 within two months of sending that letter to you we will
17 have the notice in the Federal Register. We expect to
18 beat that by a significant amount of time.

19 CHAIRMAN HALL: What would be the situation
20 as we found with flight and duty time where the ARAC
21 committee locked down and came up with no decision?
22 What would the FAA's position be then?

23 WITNESS MCSWEENEY: Well, it was -- it's --
24 because of some past --

25 CHAIRMAN HALL: And let me say, the reason I

1 ask that, Mr. McSweeney, as it says in the letter to
2 me, "FAA will then," referring to after the ARAC
3 committee, "will then act upon the ARAC recommendations
4 and make appropriate judgment and decisions on further
5 actions expeditiously."

6 Does that mean that if -- I guess just for
7 clarification, if the ARAC comes up with no
8 recommendation, or no consensus, do you have any
9 idea -- and I know you can't speak for the
10 Administrator on this -- unless maybe you can -- can --
11 what -- do you know what would be the FAA's position in
12 that situation?

13 WITNESS MCSWEENEY: Well, I certainly can't
14 speak for the Administrator, but I can certainly
15 recommend to the Administrator.

16 The ARAC is constructed this time for some
17 very good reasons, and you raised those reasons. We at
18 times in the past have seen ARAC committees get bogged
19 down because there are conflicting interests on ARAC.
20 so, we have set a specific time frame of six months,
21 and we have said we want a report that will be a
22 technical report of solutions, not issues to study.

23 It may contain differences of opinion, and
24 that is fine. We will then take that report, we will
25 then make a decision within the Agency on where to go

1 and then we will charter ARAC, or we will do it
2 ourselves, immediately prepare a notice of proposed
3 rule making for whatever decisions we believe are
4 appropriate. So, we really tried to set this up so
5 that it can be absolutely as fast track as we can make
6 it.

7 Quite frankly, the ARAC process is the only
8 process that offers the opportunity for the U.S.
9 Government to meet with private people, including
10 citizens, to discuss regulations openly and above board
11 and on the table.

12 My predication has always been that if we
13 were to take a controversial thing like this and not
14 put it into ARAC and just simply do an FAA notice, that
15 it would become so controversial during the comments
16 stage that we would actually take more time doing it
17 that way.

18 CHAIRMAN HALL: Well, I guess -- I don't want
19 to leave the impression that we are just beginning. I
20 think you had a committee, a comment period, right? --
21 that took place this year in regard to our
22 recommendations to the FAA, and the industry put
23 together a unique group.

24 In fact, it seemed to be one of the first
25 times that I have seen the international and domestic

1 manufacturers and associations all come together, and
2 they made specific comments to the FAA in regard to the
3 recommendations . Is that not sufficient?

4 WITNESS MCSWEENEY: The recommendations
5 weren't t -- the comments we received from the docket
6 weren't specific as to exactly what the solutions
7 should be for the fuel triangle, and some people
8 recommended we deal with the sparks, other people
9 recommended we deal with the fuel which showed some
10 very good promise, and other people said let's inert
11 the tanks, or let's put foam in.

12 What ARAC is going to do is take all of that
13 information, the information from the FAA and SAE fuels
14 conference and the information from this hearing right
15 here, synergize it all together and come up with a
16 solution with very specific actions being recommended.

17 CHAIRMAN HALL: Again, did you say when that
18 notice would go out to start the six month period
19 running?

20 WITNESS MCSWEENEY: We have promised to have
21 the notice out within two months of the letter to the
22 Board. We will probably beat that time.

23 CHAIRMAN HALL: Thank you.

24 WITNESS MCSWEENEY: The notice is presently
25 drafted all ready.

1 CHAIRMAN HALL: George?

2 MR. ANDERSON: Thank you, sir.

3 BY MR. ANDERSON: (Resuming.)

4 Q Mr. McSweeney, I would like to sort of back
5 up here and discuss the process by which we get from
6 the studying of the problem to the final system that is
7 on the commercial airplane.

8 I would like to just briefly list those steps
9 so that the public understands what we are talking
10 about here and where we stand. The first step in my
11 terminology would be a paper study, which we have heard
12 some of these where no hardware is being built, but
13 concepts are being evaluated and weighed and so on.

14 The next step is really what you represent in
15 the FAA, and that is the policy decision of what will
16 be required. Only when that decision is made can
17 design begin by the commercial industry, and design is
18 followed by development, and development in the case of
19 what we are hearing here may take some time because of
20 the problems inherent in using the technology that we
21 may have seen all ready.

22 The last step is to manufacture hardware, and
23 it has a lead time that may even eclipse the other
24 areas, and having said that, Mr. McSweeney, I would
25 like to point out that the military has completed all

1 these five steps.

2 They are today operating airplanes with these
3 systems on board. What I seem to be hearing from you
4 is that the FAA is still on step one. Have I missed
5 something, or have we actually gone further down the
6 road?

7 A To answer your question, I would like to ask
8 the question of the military, if I could.

9 Q Who would you like to direct it to, Mr.
10 McSweeney?

11 A Either the Air Force or the Navy.

12 Q Mr. --

13 WITNESS MCSWEENEY: My question is, does
14 either one of the gentlemen representing those services
15 believe that the existing military systems can be
16 retrofitable right now into commercial airplanes?

17 MR. ANDERSON: Mr. Lauzze?

18 MR. LAUZZE: I don't believe you would take
19 it right off the shelf and retrofit it. I believe
20 there would definitely be some study required and a lot
21 of engineering required before it would be directly
22 applicable.

23 MR. ANDERSON: I would think -- is that all,
24 Mr. Lauzze?

25 MR. LAUZZE: Yes.

1 WITNESS MCSWEENEY: I would then add, because
2 that is what I thought the answer would be, that it is
3 really not, first of all, a paper study. It is an
4 engineering study, it is a risk assessment study.

5 Anything you do in that fuel tank is going to
6 add risk. Whatever it is, you have to make sure it is
7 dealt with. Even foam adds risk to the maintenance
8 cycle. We heard that yesterday. It --

9 CHAIRMAN HALL: My only concern on that, Mr.
10 McSweeney, is why that work didn't begin in the summer
11 of '96.

12 WITNESS MCSWEENEY: In the summer of '96, I
13 don't think it was clear to anybody as part of that
14 accident investigation that foam was the immediate
15 solution to that problem.

16 CHAIRMAN HALL: I am not saying foam, I am
17 saying looking at all these military alternatives that
18 had been available and had been used, some since the
19 early 60's.

20 WITNESS MCSWEENEY: As I said earlier, our
21 folks began very soon, within a few weeks after the
22 accident, looking at all possible causes, which then
23 led us to all possible solutions. So, we have been
24 looking at things.

25 DR. ELLINGSTAD: Excuse me. Could I follow

1 up, Mr. McSweeney? In addition to the ARAC process,
2 you have indicated that there is a considerable amount
3 of research and engineering analysis.

4 What kind of resources is the FAA committing,
5 either in terms of the programs at the Technical
6 Center, or in terms of any extramural research activity
7 addressed to these activities?

8 WITNESS MCSWEENEY: What activities, now, are
9 you speaking of?

10 DR. ELLINGSTAD: We are talking about this
11 whole business of looking at controlling flammability,
12 the kinds of suggestions that have been discussed here.

13 WITNESS MCSWEENEY: Well, let me take the
14 three elements of the triangle, the fire triangle, one
15 at a time. First of all, fuel. We have written to the
16 American Petroleum Institute and asked them to form a
17 group to begin looking at using JP-5 in commercial
18 aviation as a replacement for Jet-A. So, we are
19 dealing with that part of the triangle.

20 We believe people like the American Petroleum
21 Institute have far more expertise than any of us on
22 what it would take to do that, because the cracking
23 facilities in the United States are probably the
24 greatest issue there.

25 As far as ignition sources, we have issued

1 several Airworthiness Directives, we have dealt with
2 two possible accident scenarios in our Airworthiness
3 Directives . One, quite frankly, is a notice, and I
4 recognize that.

5 As far as the -- dealing with the oxygen, we
6 have looked at and talked to people who have submitted
7 comments to our docket proposing everything from CO₂ to
8 nitrogen inerting. We have spent a lot of time talking
9 to those people that use nitrogen inerting. I
10 personally have talked to some McDonnell Douglas people
11 on the C-17 program. So, we really have made an effort
12 to look at all this.

13 Now, as far as fuel research itself, up to
14 this point we have been more than happy to be just --
15 we have been more than happy to let the NTSB lead that
16 effort. We know you have ongoing research. We
17 certainly don't -- we certainly believe it is headed in
18 the right direction. So, we have not felt compelled to
19 do any of that research ourselves. We think that it
20 would be a waste of the taxpayer's money.

21 That is basically it, in a nutshell. I could
22 give you more time if you would wish, but that is a
23 capsulation of it.

24 DR. ELLINGSTAD: No, that's fine, thank you.

25 CHAIRMAN HALL: Please proceed, Mr. Anderson.

1 BY MR. ANDERSON: (Resuming.)

2 Q Mr. McSweeney, your question of the military
3 and Mr. Lauzze is interesting, but I would like to
4 point out using my frame work here that you are asking
5 him a question that would take place after the policy
6 decision was made by the FAA to proceed.

7 He could not fairly answer your question
8 until you could tell him what requirements you have set
9 out for the systems to meet. Is that a true statement?

10 A First of all, my point in making the
11 question -- asking the question, was that even
12 when you do have the policy, you have to engineer the
13 solution to every single airplane, and what is
14 engineered into the 747 might be totally different than
15 what is engineered into any other Boeing product, not
16 to mention the fact that Air Bus and Volker (sic) and
17 others might do it differently.

18 so, each and every model of airplane has to
19 be engineered, and you are correct in saying that the
20 first step is for the FAA to establish the criteria.
21 We have to define an objective standard to define what
22 level of flammability we would be willing to allow or
23 not allow in an aircraft.

24 We would not probably, as a result of any
25 rule making action, mandate a particular solution.

1 There are many who have studied the Agency, including
2 the recent NCAR commission who have given us what I
3 believe are very appropriate recommendations to set the
4 safety objectives, not the design criteria.

5 It is entirely possible to set a safety
6 standard and have one manufacturer do inerting and
7 another manufacturer cool down the tank or remove the
8 heat sources, or something like that.

9 **Q** **Yes**, Mr. McSweeney, I agree entirely with
10 your statement, and I think it just enhances this
11 process, that what you are saying is that the policy
12 process is a daunting thing, because you must consider
13 the last three steps which is design, development and
14 manufacture, and they carry with it a lot of
15 considerations .

16 However, do you not agree that until the
17 policy information is available to the manufacturing
18 and the aircraft operators that we cannot proceed?

19 **A** Policy is certainly the first step, and that
20 is what ARAC is going to be doing. There are some
21 solutions, though, like JP-5 that don't have airplane
22 design and manufacturing problems.

23 They have other issues that have to be
24 addressed, but those issues are not with the individual
25 aircraft itself, and once solved one of those issues

1 would be solved for all aircraft at one time.

2 CHAIRMAN HALL: Mr. McKinney (sic), since we
3 are talking about, obviously, something that sounds to
4 me years in the future, Ms. Garvey's response to me on
5 page four says, "the FAA does not now see a significant
6 safety benefit from adding center -- adding fuel to the
7 center tank when it would normally be empty, but the
8 FAA is open to any future findings coming from the
9 Board's accident investigation."

10 Have you had an opportunity to look at the
11 work Dr. Shepherd has done, and would that in any way
12 impact the FAA's position, or will it at least be taken
13 under consideration?

14 WITNESS MCSWEENEY: Yes, we have had a chance
15 to look at that. In fact, the very night of that
16 presentation I held a meeting with my folks that were
17 here and we discussed that matter.

18 What we said in Ms. Garvey's letter is in
19 fact true. It still is true. What Dr. Shepherd
20 presented is information that appears to be different
21 than the information we had when we made that
22 statement.

23 CHAIRMAN HALL: But, I believe he made this
24 presentation at the Fuel Flammability Conference to the
25 whole industry, but that didn't seem to change their

1 opinion.

2 WITNESS MCSWEENEY: I was just going to get
3 to that point. The material was presented at the Fuels
4 Conference. I personally discovered that after it was
5 presented here. I then talked to lots of folks, both
6 in the FAA and outside the FAA who were at that
7 conference.

8 Nobody that I talked to could recall it from
9 that Fuels Conference. So, for some reason it wasn't
10 recognized for the value -- and I think that is an
11 appropriate term - of the presentation from that Fuels
12 Conference. I don't know why, but it wasn't.

13 CHAIRMAN HALL: Dr. Shepherd, are you --
14 well, let's let -- Dr. Shepherd, are you that boring,
15 or did you not present the information?

16 DR. SHEPHERD: Well, I sure hope I am not
17 that boring.

18 (Laughter.)

19 WITNESS MCSWEENEY: Certainly my comment was
20 not intended to be a personal comment about anybody.

21 DR. ELLINGSTAD: We might also note that the
22 proceedings of that conference were made available
23 before the conference was adjourned, including Dr.
24 Shepherd's paper.

25 WITNESS MCSWEENEY: That is correct, but I am

1 here to say for the record that that information was
2 not considered at all, because we literally didn't
3 focus on it and it did not get our attention at that
4 Fuels Conference.

5 so, the letter referred only to other
6 information, and I think we still have to spend some
7 time studying the information that Dr. Shepherd has
8 presented here, and we began that two days ago.

9 CHAIRMAN HALL: Well, that's the main thing.
10 We can have -- there is, obviously, honest
11 misunderstandings, and if it wasn't highlighted at the
12 Conference, then all I am asking is you are going to
13 consider that information now?

14 WITNESS McSWEENEY: Absolutely.

15 CHAIRMAN HALL: Thank you.

16 DR. LOEB: Mr. McSweeney, I -- just for
17 clarification on the JP-5 issue which I think is
18 certainly an interesting - an interesting prospect, if
19 we can solve the problems within this country, what do
20 we do about the issues of the availability or non-
21 availability of JP-5 outside of the country and the
22 myriad foreign countries that our carriers fly to?

23 WITNESS McSWEENEY: That certainly is an
24 issue that has to be dealt with. There are many cases
25 when other countries take the lead of the United

1 States. There are international oil societies and
2 organizations, and certainly we would be approaching
3 those.

4 The encouraging thing about JP-5 is the forty
5 degrees fahrenheit change in flammability. It
6 literally is like taking this curve over here, the tall
7 curve on the left, and dropping it down to the
8 horizontal access.

9 That would -- it is not -- I know it is not
10 mathematically that, but that is what the effect would
11 be. The other interesting point is that JP-5 is all
12 ready approved for the engines of today.

13 I want to not be overly excited about JP-5.
14 I want to put some caution in there. It does not,
15 though, give us a freezing point problem. The freezing
16 point is equal to, or a little bit less than the fuels
17 we have now.

18 so, we are not going to have a problem with
19 cold soak at altitude. It starts a little harder on
20 the ground if you cold soak an airplane with fuel
21 overnight at minus degrees.

22 But, the point is if you could in fact be
23 successful with JP-5 in getting it into the airplanes,
24 it would not require a change to the airplane. It
25 would give you an immediate improvement such that no

1 wing fuel tank would have an explosive mixture
2 immediately.

3 You might have to do more to a center fuel
4 tank to drop it a few more degrees, but our analysis
5 shows just using the flammability limits at sea level
6 that you could go from -- you could make a twenty fold
7 increase in safety in the center fuel tank on the 747.
8 That is worth going after.

9 DR. LOEB: Oh, I agree. I mean, I think it
10 is certainly something that is very worth exploring.
11 How do you intend to address this on the international
12 level, going through ICAO, or just going through a
13 bilateral process, or --

14 WITNESS MCSWEENEY: I don't think ICAO is the
15 form. I think the international oil consortiums are
16 probably the way to go. I have already had discussions
17 with Mobil Oil to try to get them very active into the
18 ARAC process. My plans in the future -- and I am quite
19 frankly haven't started the international part yet.

20 I think it is important to get the domestic
21 part going first -- but, my plans in the future would
22 be to contact people like that and see if we can get
23 the U.S. industry to stimulate that kind of
24 involvement .

25 DR. LOEB: Have you been given any indication

1 from industry what kind of time frame we may be talking
2 about to get something going?

3 WITNESS MCSWEENEY: That is the focus of our
4 letter to the American Petroleum Institute.

5 DR. LOEB: Okay. Well, did we ask for a copy
6 of that for the record? I don't think we have seen
7 that letter, and if we could --

8 WITNESS MCSWEENEY: We can certainly provide
9 it.

10 DR. LOEB: Thank you.

11 BY MR. ANDERSON: (Resuming.)

12 Q Mr. McSweeney, in view of the previous
13 remarks, it would probably be appropriate at this time
14 to ask you to describe the ARAC members that you know
15 of right now. Who are you going to invite to sit on
16 this committee, and who do they represent?

17 A ARAC is a group of people that represent
18 manufacturers, operators, flying public and citizen
19 groups . They represent all elements of aviation. The
20 FAA doesn't invite members to sit on particular ARAC
21 efforts. ARAC is a standing committee. It is an
22 advisory committee under the law. It has sixty-some
23 members, I believe, at this point.

24 Members themselves -- once ARAC is chartered
25 with something to do, the members themselves make up

1 their mind as to whether they want to be on that
2 effort, or not.

3 Sometimes we have reached out to specific
4 members and specific elements of the community and
5 said, "This is important and your input is very
6 important and, so, we would really encourage you to be
7 on this particular ARAC effort, because without your
8 input into the synergy of the solution, we don't think
9 we will probably have the right solution." That is
10 kind of how it works.

11 Q Let me try some names. Would representatives
12 of the airlines be on this ARAC committee?

13 A Yes.

14 Q Would representatives of the Air Transport
15 Association be on this committee?

16 A I believe so.

17 Q Would members of manufacturers who
18 manufacture foam products, would manufacturers who
19 manufacture the various types of nitrogen inerting be
20 on this committee?

21 A That question, I don't know at this point.

22 Q Would that be a good idea?

23 A To get the input from those people, yes, that
24 would be a very good idea.

25 Q I was --

1 A You can be a member of the active working
2 group and be representing anybody and not be on the
3 full committee, though. It is possible for that to
4 happen.

5 Q Why would they not be a full member? Why
6 would they be different?

7 A ARAC, up to this point, has been a fluid
8 group. People have joined as they see many times the
9 opportunity to involve themselves in regulatory actions
10 with the Agency.

11 I don't know why the industry that represents
12 any kind of foam or nitrogen inerting haven't been on
13 ARAC . You would really have to ask them. I would
14 assume that if they want to become involved and be a
15 member of ARAC right now that their application would
16 be appropriate.

17 We do not invite or bar anybody from being on
18 ARAC . I mean, it is an industry, it is a public thing.

19 Q I understand, sir. In your opinion, as we
20 sit here today do you believe that it would be
21 advantageous to this process to have representation
22 from these industries?

23 A Yes, I do.

24 Q Thank you. I would like to ask another
25 question, Mr. McSweeney. In your role of setting

1 standards which, of course, as we said before, is the
2 very beginning of this process of getting safer
3 airplanes, is there anything in the certifications
4 regulations that you write and make available to the
5 industry that limits the amount of safety that an
6 operator can put on his airplane?

7 In other words, are there airplanes out there
8 that are safer than others because of their designs?

9 A Our regulations define a very high level of
10 safety. One of the things that I absolutely despise is
11 the word "minimum." It is a legal term, I believe. It
12 is minimal -- it is the minimum standards that are
13 required, but they certainly are not minimum safety.
14 We set a very high safety standard.

15 When the FAA certifies an aircraft, it
16 certifies that that aircraft complies with those very
17 high standards. It does not say that that airplane is
18 safe, or that one airplane is safer than another. It
19 says that the standards on which that safety have been
20 judged have been met.

21 We do not have a way -- and I don't believe
22 anybody has a way -- of looking at an airplane and
23 saying overall it is safer than another airplane. It
24 is a very -- it would be a very complicated thing.

25 There are airplanes that for some very good

1 reasons, like airline dispatch requirements, have
2 components in them that go beyond -- and levels of
3 safety that go beyond what the regulations require.

4 Those are for economic reasons. They are not
5 for safety reasons. They are so that when you are
6 sitting at the gate and a particular component happens
7 to fail, they can go to the master minimum equipment
8 list, or their minimum equipment list, they can do what
9 is necessary and dispatch the airplane so the hundreds
10 of people on that airplane can get to their
11 destination. So, that is kind of why that equipment is
12 in there.

13 (Tape change.)

14 Q Thank you, sir. Is there -- let's take a
15 hypothetical situation in which an airline decided that
16 they wanted to speed up the process that we perhaps are
17 beginning here and try an advance type of system.

18 Would there be anything in the certification
19 regulations that would prohibit somebody from moving
20 ahead in a more quick manner? -- and the FAR is what I
21 am referring to.

22 A There is nothing prohibiting anybody from
23 putting anything in the airplane that will improve
24 safety. We would have to do two things. We would have
25 to make sure that it is, in fact, an improvement in

1 safety, and we would have to make sure -- and this is
2 most important - that it is fully certified as
3 improved before it goes in airline passenger operation.

4 In other words, we don't use airline aircraft
5 to do any kind of testing. It would have to have been
6 totally proven out before then.

7 Q But, if an airline decided they wanted this
8 to begin, would you work with them and would you
9 accelerate the process so that they would be able to do
10 this?

11 A Oh, absolutely. I mean, we would be more
12 than willing to work with anybody about anything that
13 has to do with safety.

14 Q That gets me back to our discussions
15 yesterday. Would the military's experience and the
16 fact that the military has fielded systems that are
17 operating help you and speed you on that process?

18 A Well, that's almost a given in my mind. I
19 mean, any technical information that has been -- that
20 is available from past efforts is certainly going to
21 speed up a future effort, because we all learn by
22 connecting what we know to what new information we
23 have.

24 Q Thank you, sir.

25 A That is the way the human works.

1 MR. ANDERSON: I would like to go to Mr.
2 Thomas just for a side question here along this line.

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

1 DIRECT EXAMINATION

2 BY MR. ANDERSON:

3 Q Good morning, Mr. Thomas. To your memory,
4 has Boeing Aircraft ever received specific requirements
5 for an airplane that they bought which weren't your
6 generic offering?

7 A Could you repeat the question?

8 Q Yes. When a customer comes to you, have they
9 asked for special features that you don't routinely
10 offer on a --

11 CHAIRMAN HALL: Mr. Anderson, let me get this
12 more specific. Mr. Thomas, first of all, I
13 appreciate -- what is this, your fourth or fifth panel?

14 WITNESS THOMAS: Fourth time, I believe.

15 CHAIRMAN HALL: That is -- and as anybody who
16 has had the opportunity to sit under these lights, you
17 know what a pleasure that is.

18 WITNESS THOMAS: Yes.

19 CHAIRMAN HALL: You know, the Safety Board
20 has 400 employees. The FAA has about 40,000, and about
21 4,000 of those are in Flight Standards. Boeing is the
22 flagship industry of our nation, with over 200,000
23 employees.

24 Could you tell me what you all have done
25 since the TWA accident in the area of looking at foam,

1 looking at inerting, looking at the possibility of any
2 technology that would keep wires out of fuel tanks, any
3 things that would run the wires for the fuel quantity
4 indication system in a - separate from the low signal
5 wires, or to add some shielding which I think is
6 usually done in the chemical industry any time you have
7 parallel wires like that run?

8 What has Boeing done in that regard since the
9 accident?

10 WITNESS THOMAS: That is a long question.

11 Let me try and answer it. We have been studying all of
12 these options basically since we realized that we were
13 not going to find an easy solution to TWA 800.

14 It became very obvious we needed to expand
15 our attention. The NTSB recommendations focused our
16 attention on a lot of these things. We undertook to
17 study those things.

18 We have looked at fuel tank inerting, we have
19 looked at foam, we have looked at JP-5, we have looked
20 at ullage sweeping. We have done all of these things.
21 We have looked very carefully at our systems. We
22 continue to do so.

23 We have looked at are there techniques to get
24 away from electrical driven fuel pumps. These things
25 are all the issues we have been looking at. Shielding;

1 I am not an electrical engineer. I know we have
2 discussed it at length as to the options.

3 Some of our later airplanes are shielded
4 already simply for performance reasons, particularly
5 the later airplanes where we changed technology in how
6 we sense the signals to and from the gaging system.

7 We required those systems be shielded, so we
8 have incorporated those into the later airplanes. Not
9 for safety, per se, but for performance reasons where
10 there are some side benefits from that. So, we have
11 done all of that.

12 We were -- a lot of that is -- you referred
13 to the industry response to the FAA. A lot of those
14 studies are documented in that response. I was
15 literally technical leader, if I can use that term, of
16 that response, and a lot of the work was based upon
17 studies done at the Boeing Company and in cooperation
18 with McDonnell Douglas.

19 At the time we did all of that work,
20 McDonnell Douglas was still a separate corporation and
21 we cooperated with McDonnell Douglas, we cooperated
22 with Air Bus and we cooperated with Lockheed.

23 CHAIRMAN HALL: Have you -- do you anticipate
24 participating in this ARAC committee that the FAA will
25 put together?

1 WITNESS THOMAS: The Boeing Company certainly
2 will participate.

3 CHAIRMAN HALL: What is done in the Boeing
4 Company between the military side of the house and the
5 commercial side of the house in sharing safety
6 information on similar products, aircraft types, and
7 what have you done?

8 Are there any of the Boeing aircraft types
9 that have the foam or the inerting systems? Any
10 experience that you would want to share with us?

11 WITNESS THOMAS: Yes, sir. Certainly. The
12 answer to the first part of your question as far as
13 sharing information; there is a -- not what I would
14 call a formal process of us going over to the military
15 side of the house and vice versa.

16 We do on a regular basis exchange employees.
17 If the military has a need for a two year project, one
18 of our engineers, or two or three of our engineers will
19 be loaned to that military project. When they come
20 back, they will bring that information with them.

21 I certainly have been involved in that kind
22 of thing. So, most of the fuel system -- particularly
23 the senior fuel system people get involved. One of the
24 issues, obviously, on the military side of the house is
25 security.

1 We have black holes where people literally
2 disappear for six months and, you know, we just do not
3 see or hear from them. You know, we know they are
4 working on a military project.

5 When they reappear in the commercial side of
6 the house, they actually cannot talk about the
7 specifics of what they were working on, but if there is
8 some particular safety benefit, then that becomes
9 available.

10 A good example of that is the study of a fuel
11 tank inerting system we reported in our response to the
12 FAA . We had two key players in that activity in the
13 Boeing Company, both of whom had worked on military
14 airplanes and were very, very familiar with the
15 military side of the house and development of the OBIG
16 system.

17 We use the military side of the house, the
18 computer codes, the size, the OBIG system. We used
19 those codes to develop the response that was in the --
20 that we sent to the FAA. So, there is a lot of -- I
21 think -- I myself, personally have worked at various
22 times on fuel tank inerting. We have looked at foams.

23 The presentations that were given yesterday,
24 I was certainly familiar with all of the information
25 presented.

1 CHAIRMAN HALL: Can you give us again what
2 specific information - action has been taken by Boeing
3 since - under service bulletin since the accident in
4 regard to the 747 center fuel tank system?

5 WITNESS THOMAS: I am not sure I can come up
6 with a complete list. I can certainly sit down with --

7 CHAIRMAN HALL: Well, we will take a break
8 here in a little while, and if you could get the table
9 to do it. I would like to just have on the record the
10 things that the company has done, and I understand that
11 you all had some concerns about inerting. Do you want
12 to put those on the record?

13 WITNESS THOMAS: I would certainly like to
14 speak to that after the break.

15 CHAIRMAN HALL: Okay. I am sorry, Mr.
16 Anderson, I keep interrupting, but it is day five. Go
17 ahead.

18 MR. ANDERSON: Thank you, sir.

19 BY MR. ANDERSON: (Resuming.)

20 Q Mr. Thomas, following on, I am interested in
21 the perception of your customers over time. Has
22 anybody discussed inerting or other means of enhancing
23 protection of fuel tanks on any of your products?

24 I would ask you to consider both your
25 military and commercial customers. Have they inquired

1 about these programs? Have you bid to the military to
2 produce an alternate system than what is currently in
3 use?

4 A Excuse me, what was the word you used? --
5 bid?

6 Q Bid. When you -- normally the process of
7 obtaining business from the military is that you bid.
8 You submit a bid where you have a design and the
9 military evaluates it, and if they like it they award
10 you the contract.

11 A As I demonstrated, I am not familiar with the
12 military side of the house. I have been in the
13 commercial side of the Boeing Company for all my
14 career.

15 As far as customers coming to us, yes, the
16 customers have come and asked our opinions on a lot of
17 these issues. We have responded. Certainly when we
18 put together the response to the FAA, a lot of our
19 customers were involved in looking at those responses.

20 Q Thank you sir. I --

21 CHAIRMAN HALL: Mr. Thomas, so I understand,
22 if you don't think it is unfair for the Chairman to
23 ask, since the taxpayers basically fund the military in
24 this country, that if there is safety information that
25 that somehow gets transferred? I don't want to be out

1 of order here.

2 WITNESS THOMAS: No, absolutely, sir. I
3 think what we try and do --

4 CHAIRMAN HALL: And I don't think that most
5 Americans want -- you know, they are not interested in
6 strafing areas in their commercial planes, so there is
7 a difference.

8 But, if there is safety things; fuel tank,
9 electrical system, things like that, you know, could
10 you maybe look at how you might be sure you got all
11 those safety benefits being exchanged?

12 WITNESS THOMAS: Yes, sir. I think that
13 is -- I think a lot of what is going on takes place in
14 the open committees, the SAE meetings, those kinds of
15 things .

16 There is -- that is probably where the
17 military and the commercial side come together for
18 conversations and to catch up with what is going on.
19 We have members on those SAE committees.

20 They bring back information. I see regular
21 reports from those activities. That is probably why I
22 know -- I am pretty familiar with most of the topics
23 that have been talked about this morning.

24 CHAIRMAN HALL: Well, again, that is what got
25 me back -- you know, the testimony -- I guess it was

1 Dr. Ball about losing the 5,000 planes during the
2 Vietnam era and how much better we did in the Gulf War
3 and, you know, that is all technology and things we
4 learned through the loss of American lives and the
5 expenditure of American dollars, and I would just like
6 to be sure we have that benefit on the commercial side,
7 as well.

8 WITNESS THOMAS: On that point I would -- for
9 the record, when we have been talking about looking at,
10 you know -- I lost the right word -- external threats
11 to the airplane. When we were considering those we
12 engaged with our military people. The survivability
13 and vulnerability people on the F-22 were brought into
14 the team and supported us for many, many months.

15 CHAIRMAN HALL: What are you doing on the
16 fuels area? Did we touch on that, Mr. Anderson?

17 MR. ANDERSON: I would like to develop --

18 CHAIRMAN HALL: Is that a future question?
19 What, have you all been looking at any alternate fuels?

20 WITNESS THOMAS: I believe we were the
21 company that proposed looking at JP-5, sir, when we
22 first started talking about this. Because of the forty
23 degree shift to the right, if you will, on the curve of
24 the flammability, we could see there was some
25 significant benefits and, as Mr. McSweeney has said, it

1 becomes an option that becomes readily available to all
2 the fleet.

3 CHAIRMAN HALL: Dr. Shepherd, have we looked
4 at JP-5? Is that something that could be incorporated
5 in your work?

6 DR. SHEPHERD: We could do that, but we
7 haven't done that at this point.

8 CHAIRMAN HALL: All right, but we might --
9 that is something we might want to get Mr. McSweeney
10 and Mr. Thomas' input on, and that is something that we
11 ought to do as part of this -- your ongoing efforts --
12 that is something we ought to consider.

13 MR. BIRKY: Mr. Chairman, could I follow up
14 on a question you had asked a little while ago of Mr.
15 Ivor Thomas? After the Filipino explosion, I know we
16 talked rather extensively about the technology of
17 gaging the tank without putting wires in the tank.

18 Is any technology being pursued, development,
19 or what is available to do that at this time?

20 WITNESS THOMAS: At the present time the
21 technologies we have looked at on the 777; we use a new
22 technology called ultrasonic technology, which is in
23 layman's terms a sonar pinger at the bottom of the tank
24 that sends a pulse of sound to the fuel servers.

25 It bounces back down, and you time the -- you

1 basically measure the time it takes to travel that
2 distance, and then the computer calculates the height
3 of the fuel and then calculates how much fuel is in the
4 tank. That is the technology. That still involves
5 wiring going into the tank.

6 We have looked at and have tested -- what's
7 the right word? -- pressure sensitive systems. In
8 other words, it will have three pressure sensors in a
9 triangle. I can measure the height of the fuel from
10 those three pressure sensors and also the angle of the
11 surface.

12 so, if I now know the attitude of the
13 airplane and the angle of the surface, mathematically I
14 can calculate how much fuel is in the tank. We have
15 tried that in a limited experiment. The problem there
16 is the accuracy of the pressure transducers and the
17 reliability of the pressure transducers to be able
18 to -- you know, we want to be able to measure a quarter
19 of an inch so we can calculate the fuel accurately
20 enough.

21 We currently have gaging systems that are
22 accurate to half of one percent of the tank. If you
23 are lucky, your average gas gage is probably good to
24 maybe twenty percent. My car at low fuel volumes is
25 hopelessly inaccurate.

1 so, in that regard it is very important if
2 the gentleman next to me wants to know how much fuel is
3 in his airplane. As a result, we have to be very, very
4 accurate and very reliable. So, we have looked at
5 those things. So, I think that answers the question.
6 We continue to look at alternatives.

7 People have proposed fiber optic systems to
8 look at fuel tanks, also.

9 CHAIRMAN HALL: Mr. Thomas, since this, have
10 you all looked at what is done in the chemical industry
11 and the nuclear industry? I have gotten so many
12 letters from people with Ph.D. and stuff after their
13 name saying, you know, these -- we had these things and
14 experiences in the marine industry, and I know it is
15 not exactly compatible, but is there anything we can
16 learn from the experience in other industries? Have
17 you all looked at those?

18 WITNESS THOMAS: At this point we have done
19 some limited looking. I think we need to go further.
20 We have some engineers who have been in the oil
21 business, or the petrochemical industries. So, we get
22 some feedback from those people and we discuss it.

23 We have not pursued that at a high level. We
24 have been focusing on other solutions, like JP-5. So,
25 I think we need to continue with that expansion of our

1 knowledge base into the petrochemical industry and
2 nuclear industry. But, we have not done a lot at this
3 point.

4 CHAIRMAN HALL: Well, my brother is a
5 chemical engineer. He went, unfortunately, to
6 Vanderbilt University.

7 (Laughter.)

8 I went to the University of Tennessee, but he
9 has been talking to me since -- everybody talks to the
10 Chairman about this accident, and I am pleased to hear
11 you are going to pursue those things, because he thinks
12 there are things that might be able to be learned from
13 the refining and chemical industries.

14 MR. BIRKY: The interesting thing, I think,
15 from the chemical industry is they start with a little
16 bit of a different philosophy or premise; they cannot
17 design out all ignition sources, so they have to take
18 some other action.

19 I wonder if that philosophy would be
20 applicable in this environment we are talking about.
21 so, I am suggesting we might look at removing all
22 electrical systems from a tank, for example.

23 WITNESS THOMAS: We have talked about that.
24 As I said, we have talked about going to non-electrical
25 FQIS fuel gaging systems. We have talked about non-

1 electric pumps, or moving the -- you know, finding some
2 non-electrical devices that we could use.

3 We have talked about that. That is a fairly
4 long research project to develop these things. Our
5 current technology has taken us a long time to develop
6 to the state of the art where it is right now. We need
7 to go further, I think.

8 There is -- I came back to the Chairman's
9 comment about the military. I think the military has
10 probably used more hydraulically driven pumps and other
11 such things on the fighters than we ever have, and I
12 think there is a database that we need to go and
13 explore.

14 CHAIRMAN HALL: We don't have any of the
15 engine manufacturers involved as a party to this
16 investigation, but Mr. McSweeney and Mr. Thomas, are
17 you all working with them in terms of the JP-5 and
18 looking at the fuels, as well, and they will be part of
19 the ARAC group?

20 WITNESS MCSWEENEY: Yeah. Two weeks ago I
21 contacted my - the Director and Manager and the Engine
22 Director who reports to me to make sure that they had a
23 specific effort working with the major engine
24 manufacturers to begin looking at JP-5 well before even
25 we got into it on ARAC, to make sure all of the data

1 was ready to go, and they have looked at it. I since
2 have received two pieces of information back.

3 CHAIRMAN HALL: Let me apologize and correct
4 the record. Dr. Loeb correctly points out that we do
5 have an engine manufacturer as a party, but they have
6 not been designated as a party to this hearing because
7 that was not an issue.

8 WITNESS THOMAS: If I can follow up on Mr.
9 McSweeney's reply as far as involving the engine
10 companies. I am the Chairman of the Propulsion
11 Harmonization Working Group, which is another working
12 group to look at the harmonization of rules also
13 sponsored under the ARAC process.

14 We had a meeting in Phoenix probably six
15 weeks ago where we discussed at length the upcoming
16 ARAC activities to make sure that all the engine and
17 the auxiliary power unit people, which are also
18 involved in this, were aware of this upcoming activity.

19 so, I think the industry is aware. We are
20 ready. We will work with the FAA on this very hard.

21 CHAIRMAN HALL: Mr. McSweeney, how would you
22 involve the military, these three gentlemen at the end
23 of the table that seem to have some knowledge in this
24 area? Would they be on the working group, or could the
25 working group access their information?

1 WITNESS MCSWEENEY: Well, whether or not they
2 are on the working group, I would leave it up to them.
3 But, certainly to proceed forward and not access their
4 information would be wrong. So, we are certainly going
5 to have to do that.

6 CHAIRMAN HALL: Thank you.

7 BY MR. ANDERSON: (Resuming.)

8 Q Mr. McSweeney, I would like to follow up on
9 that. Would you invite -- be prepared to invite them
10 to participate today?

11 A On the working group, yes, we can do that.
12 As a member of ARAC, it -- it -- I don't know the
13 process by which we would do that. But, as a working
14 group -- we have had -- we have had the military
15 involved in our programs at the Tech Center, be it
16 Halon replacement, or be it investigations of fuel and
17 flammability in the past.

18 We have direct contacts in the research
19 community with the military on a great deal of -- a
20 great number of projects. So, it wouldn't be unique
21 for us.

22 Q Yes, sir. I -- what I am getting at here is
23 not that the military has not been consulted or that
24 you are unaware of their research, but there is a
25 communication process going on with that committee

1 where people make inputs and reports are generated.

2 It would be comforting to know that their
3 inputs would be made in that final report. Do YOU
4 understand?

5 A Well, yes. I already said yes, they would
6 be.

7 Q Yes, and -- so, because most people see the
8 results; they don't see the process. So, if things get
9 lost in the process there is no way of tracking it
10 anymore.

11 At any rate, I wanted to kind of bring to
12 closure this area of discussion, and to do that I
13 wanted -- we are going to get into later the FAA's
14 request for public comments on the NTSB recommendation.

15 We have a copy here. There were over 700
16 pages of public comments received by the FAA relative
17 to your request. So, we would like to discuss that,
18 but before that, because I think it is relevant to what
19 we have been discussing, especially with Boeing, we
20 have a letter here from a person who represents a
21 company who produced foam, Kaleidoscope Company.

22 I would just like to read into the record
23 just a short part of this discussion, because this is
24 another view of what we have been discussing, and I
25 quote, "Any change to the 747 fleet or others will

1 require engineering and some engineering changes."

2 "The penalties and added weight, cost, fuel
3 capacity and added other costs are expected. A 747
4 center wing tank foam kit would require about twenty
5 days design work, and an additional thirty days to
6 provide a proof kit. Kit costs un-installed would be
7 less than \$100,000 each," and so on.

8 This is an opposing view that I believe
9 should be considered in this committee, and I am
10 concerned that there should be some representation of
11 these kind of specific numbers.

12 A You know, as I have already said, we are
13 going to consider all that input. I would ask you,
14 though, if you are going to put that comment in the
15 docket that maybe the other thousand pages of comments
16 ought to be also in the docket because that is the only
17 way I think the American public are going to see what
18 all the comments have said.

19 CHAIRMAN HALL: That will be done. Let's put
20 the whole comments in the docket.

21 MR. ANDERSON: Yes, we will certainly be glad
22 to do that, and when we proceed further we will try to
23 call upon your memory and deal with those that you feel
24 are helpful to illustrate the problems.

25 CHAIRMAN HALL: The only thing, Mr.

1 McSweeney, I would like to mention is that -- and the
2 reason I think Mr. Anderson is pursuing this and we are
3 concerned about it is that there were a lot of
4 representations .

5 We understand that things have to make sense
6 dollar-wise, but, you know, we had an experience here
7 recently with the Value Jet accident where the
8 estimates and the actual cost of installing the
9 suppression equipment in the cargo holds turned out to
10 be dramatically different.

11 Since you do have to go through a cost
12 benefit analysis on some of these items under the
13 present process, we want to be sure that you are
14 getting a wide range of estimates from individuals and
15 manufacturers and airlines and other interested
16 parties. So, that is -- I think that is one of our
17 concerns.

18 WITNESS MCSWEENEY: I certainly share that
19 concern, and I thank you for affording people the
20 opportunity to see all the comments.

21 I think the first issue that we are going to
22 address, though, is not cost. The first issue we are
23 going to address is safety, and we have got to look at
24 the safety objective of where we are headed in this
25 effort, and that has to drive everything we are doing.

1 MR. SWAIM: Mr. McSweeney, I have a question,
2 a couple of questions for you before we get too far
3 from our last part of the conversation.

4 In the 70's the FAA -- you had mentioned that
5 the flammability studies previously were for post-crash
6 fires. In the 70's the FAA went so far as to SDC a DC-
7 9 with a nitrogen system.

8 My question is, what is to keep this effort
9 going that it does not get like the post-crash fire
10 fuel misting effort and run out of steam at some point
11 there? How many NRS'S or other people do you have
12 dedicated to this type of an effort?

13 WITNESS MCSWEENEY: We have -- not counting
14 the people at the Tech Center that are supporting us
15 and have a lot of experience in this area, we have
16 spent on this accident I would say over 15,000 hours of
17 work, and at one time or another I have had over 100
18 people working on this program.

19 I don't know how I would respond to a
20 presumption that maybe we will slow down our vigor on
21 this effort, because all I can say to you is this
22 effort has been a top effort in our organization.

23 It has been one that I have personally been
24 involved in. I brought nine personal notebooks of
25 information to this hearing that I have amassed myself,

1 and I am not making the technical decisions. I am a
2 manager.

3 so, we are on top of this as much as we can
4 be. I have 1,000 resources at my beck and call. About
5 350 of those are engineers. We will put whatever
6 people we need to on this -- on this effort.

7 I think it is important to recognize that the
8 real message behind Ms. Garvey's letter is that we
9 have -- there is no doubt, we are going to do
10 something. What is up for debate is how are we going
11 to take those three sides of the triangle and develop a
12 synergy of those solutions that is the best solution
13 for this and all other possible ignition sources.

14 MR. SWAIM: Great, thank you. That is what I
15 wanted to hear. My next question is -- you had
16 mentioned -- you had used the word "minimizing the
17 flammability" earlier. My question is, how far in
18 general terms are we talking?

19 Are we talking a six percent reduction in the
20 time that we have a flammability problem, or are we
21 talking about reducing to six percent the exposure, or
22 are we talking about trying to make it go away totally?

23 WITNESS McSWEENEY: I believe the words I
24 used and the words that are in our documentation are
25 "minimize or eliminate." We haven't ruled out

1 eliminating.

2 so, the key is, if you look at some of the
3 possible solutions you have, I think that whole range
4 from where we are today to total and absolute
5 elimination. We haven't ruled that out.

6 What we want to do is to see what are the
7 possibilities that is out there. If JP-5, for
8 instance, proves out, we could probably get a twenty
9 fold reduction in accidents, twenty fold increase in
10 safety. What we -- what you might want to add to that
11 to get you down to zero times in flight when you would
12 have an explosive mixture might be quite minimal.

13 You could also look at it from, "well, we
14 won't deal with the fuel, we will deal with inerting
15 the tanks." Whatever the solution is, I think it all
16 has to meet the same safety objective of significantly
17 reducing or eliminating explosions in fuel tanks.

18 MR. SWAIM: Thank you. George?

19 MR. ANDERSON: Thank you, sir. I would like
20 to go over to Captain Steve Green at this time.
21 Whereupon,

22 CAPTAIN STEVE GREEN,
23 was called as witnesses by and on behalf of the NTSB,
24 and, after having been first duly sworn, was examined
25 and testified on his oath as follows.

1 DIRECT EXAMINATION

2 BY MR. ANDERSON:

3 Q Good morning, Captain Green.

4 A Good morning, Mr. Anderson.

5 Q I want to say first that when we put together
6 this panel I think that the -- Mr. Green representing
7 ALPA, Air Line Pilots Association, we were at least a
8 little bit wondering where -- why they belonged on this
9 panel, and my feeling about it was that we had to
10 discuss among the other complexities the importance of
11 the final operator of any new modification or system,
12 or whatever came out of this process of change.

13 Captain Green, we have been discussing some
14 significant potential here that would affect the
15 commercial air fleet. I would ask you, what are some
16 of the operational concerns. That would be from the
17 crew members, the maintainers and the people that you
18 work with every day that you would envision as meeting
19 scrutiny - and I know that you have some other
20 comments concerning the methodology that might be used
21 to approach this.

22 A Okay, I think I can address that. I first
23 wanted to establish, Mr. Chairman, some of my basic
24 credentials. Number one, I have been in the center
25 tank; two, I have read Dr. Ball's book; and three, we

1 will be at the ARAC.

2 so, we have covered most of those issues, I
3 think, all ready. Can I put up my first slide?

4 (Slide shown.)

5 Thank you. I want to borrow a little bit
6 from Dr. Ball's book and go back to his basic equation
7 of combat survivability in which he said that that was
8 equal to one minus susceptibility times vulnerability.
9 In his case, he is defining susceptibility as exposure
10 to a military damage mechanism, a missile round or some
11 type of weaponry, and vulnerability is the damage
12 mechanism in tolerance that the airplane exhibits.

13 I think part of the effort here is trying to
14 develop a way to write across some of the military
15 design philosophy into the civilian sector, and I think
16 we can do that beginning with this equation.

17 If we move into the civilian side of the
18 house, we can write this to say that Flight Safety will
19 equal one minus the susceptibility times the
20 vulnerability, as well, except in our case we define
21 the susceptibility differently.

22 It is not a combat threat, it is an exposure
23 to a system failure and/or a damage mechanism within
24 the system. Our vulnerability remains very much the
25 same. It is an intolerance to system failure, or the

1 damage mechanism.

2 I think the thing that is significant to
3 focus on here is that the susceptibility we are dealing
4 with is very different from the susceptibility that the
5 military is dealing with. We carry our damage threats
6 on board the airplane. They are not located at some
7 geographic site that either can be avoided or perhaps
8 not avoided.

9 In other words, I don't have the opportunity
10 to elect to operate within the exposure area. I am
11 operating in the exposure area from the time I step on
12 the airplane to the time I step off.

13 That really is what has driven the civilian
14 approach to this all along. If we take the Flight
15 Safety term, we want to make it one. There are a
16 number of ways that -- well, two ways we can do it.

17 One is we can drive susceptibility to zero,
18 or we can drive vulnerability to zero, or we can do
19 both. Traditionally, we try to drive susceptibility to
20 zero because we are exposed to that damage source all
21 the time.

22 As I said, it is part of our mission. We
23 can't say, "well, today the inerting system doesn't
24 work, so we are not going to fly this airplane in
25 combat. "

1 This remains an important concept, but what
2 we are proposing now is that we move towards driving
3 both of these terms to zero, which obviously enhances
4 the opportunity to get a one out of the Flight Safety
5 number.

6 But, I think we want to be careful that we
7 don't look at this as a swap of philosophies. In other
8 words, I don't want to do away with the approach of
9 eliminating ignition sources. I have got to have a
10 fuel tank with no ignition sources in it, even if I
11 inert the tank because, depending on the design, I
12 don't know if my inerting system is going to be with me
13 all the time, or not.

14 What is even more important is that a similar
15 damage mechanism may attack other vulnerabilities, and
16 one of the things that I think we may have forgotten
17 here is that due to the outstanding work, for the
18 record, that Mr. Swaim has done in investigating
19 aircraft wiring, we may have identified a damage
20 mechanism that can do me a lot of damage in a number of
21 other ways besides exposing an ullage. So, that damage
22 mechanism becomes very interesting in and of itself.

23 Reducing that susceptibility has to remain
24 primary because of the capability of that damage
25 mechanism to influence other vulnerabilities, and then

1 also because my vulnerability reduction, if it is
2 inerting, or what have you, depending on design, may
3 fail during flight.

4 If I am half way across the Atlantic with a
5 nitrogen inerting system and the little light comes on
6 and says that the inerting is no longer maintaining a
7 nine percent oxygen content in my tank, it has gone up
8 to fifteen, I hope there are no ignition sources in
9 there. I can't afford that.

10 so, this is really not a design philosophy
11 swap. It is an improvement in design philosophy, and a
12 radical improvement and a needed improvement. But, it
13 is a little different than perhaps the way it has been
14 portrayed in the media to date.

15 From our perspective, vulnerability reduction
16 must, first of all, have no adverse impact on aircraft
17 system reliability. Now, Mr. Thomas mentioned the
18 other day that the primary purpose behind the fuel
19 system is to provide a reliable and safe fuel flow to
20 the engines, and I am rather fond of that.

21 I cannot afford any adverse impact. I can't
22 have a vent valve cause me a flow problem. I don't
23 have vent valves now, but I would if I put a nitrogen
24 inerting system in it, or some designs of it.

25 I can't have a piece of hydrolytically

1 unstable foam wandering around the fuel system. These
2 are all considerations. They are not insurmountable,
3 but they are all considerations that we have to focus
4 on.

5 Secondly, one of the interesting aspects of
6 some active inerting systems is that it moves the
7 responsibility for maintaining a safe fuel tank into
8 the cockpit to one degree or another, and that's fine.
9 We have a number of other systems we are responsible
10 for.

11 We are not necessarily objecting to having an
12 additional one, but if we go that particular route, if
13 that is the option that is chosen, the system needs to
14 exhibit a safe and reliable man-machine interface. We
15 don't want to have a system that comes into the cockpit
16 that introduces a couple more problems that open
17 themselves up to human error, et cetera, et cetera.

18 Finally, I think, you know, the thing that is
19 also important - and for this reason we had more or
20 less independently arrived at the conclusion that JP-5
21 was a very interesting alternative. We need to apply
22 this to all fuel tanks.

23 The center fuel tank is the focus of
24 attention for obvious reasons, but if we go back to the
25 Madrid accident we see the affects of an outboard wing

1 fuel tank explosion. We really can't tolerate any fuel
2 tank explosions, and we need to apply it to all
3 aircraft and scheduled passenger service, and I think
4 the Board is familiar with that area of discussion.
5 But, we have been focused on large aircraft. We think
6 the solution needs to incorporate everything down to a
7 Beach 1900 and right on up.

8 The most important thing, as I said, though,
9 is the design philosophy that exists today must not
10 change. It must be augmented by vulnerability
11 reduction. But, we can't afford to let go of that
12 susceptibility issue. Again, I am really interested in
13 the other ramifications of some of the ignition source
14 possibilities that we have been talking about.

15 That pretty much concludes that area that I
16 wanted to talk with you about.

17 CHAIRMAN HALL: Well, let me just comment on
18 that briefly, Captain Green. I think your thoughts are
19 well thought out and well presented.

20 The Safety Board's position has been a two-
21 track approach to continue to look at removing the
22 possibility of the ignition sources which has to be
23 done, as well as addressing the subject of explosive
24 vapors which previously had not been as fully addressed
25 as the other subject had been.

1 1, again, am very pleased to see that from
2 both the Federal Aviation Administration and the Boeing
3 Commercial Airplane Group that that is a commitment
4 that the American people now have, that those both are
5 going to be addressed.

6 In addition, we looked in our recommendations
7 at both the short term and long term, because we
8 realize that a lot of this involves design engineering,
9 and you don't want to put anything on the airplane that
10 would cause it to be less safe. But, SO, we had made
11 short term and long term recommendations.

12 so, I thank you for a well thought out, well
13 presented presentation. Mr. Anderson?

14 MR. ANDERSON: Thank you, sir.

15 BY MR. ANDERSON: (Resuming.)

16 Q Captain Green, you made I believe an
17 important point when you talked about the -- rather,
18 extending this problem to handle all airplanes,
19 basically referring to size and type, but that are
20 endangered.

21 Could you expand on that a little more and
22 sort of give your concept of that complexity?

23 A I think it goes back to a requirement.
24 Again, as I think we have all been discussing, if we
25 can establish, which is what we would hope to do

1 through the ARAC process, a requirement for reducing
2 the flammability of a tank, then it falls upon the
3 manufacturer to decide what technology he is going to
4 use to do that.

5 There is obviously a variety of
6 opportunities, and I don't think there is any need for
7 all airplanes to use the same technology. The concept
8 of a nitrogen inerting system on a Beach 1900 has got
9 to be kind of overwhelming to the poor folks at
10 Raytheon, and yet it may be reasonable for an airplane
11 such as the 747, depending on how it is developed.

12 We are very interested in -- and
13 consequently, we are very interested in universal
14 solutions, beginning with a look at JP-5 or derivative
15 fuels, because obviously they apply to all turbine
16 powered airplanes and it is a rather elegant solution,
17 if it is a solution at all.

18 Foam is another interesting angle, because it
19 is applicable to small fuel tanks. The military has
20 made good use of it in small fuel tanks. It also has
21 no moving parts, which is something we also find very
22 attractive.

23 But, I think the main thing that is important
24 is that we establish a requirement for how we are --
25 you know, what the flammability must be, or what the

1 reduction must be in the tank and then move on from
2 there.

3 Q I understand. As a charter member of the
4 group that will be attempting to produce
5 recommendations, are you comfortable that the obvious
6 bias that is a natural part of diverse group of parties
7 coming together to do a technical job is going to be
8 held in abeyance while this important work continues?

9 What I mean by that is, I detect a strong
10 bias against certain technology, and I understand that
11 probably part of that is because of the daunting costs
12 or the unknowns, but how does one, when you are
13 drafting policy, not be thinking about these? How
14 would you imagine that would be put aside?

15 A I think that is an interesting question. I
16 think you are referring specifically towards the ARAC
17 process, or something of that nature?

18 Q At least the ARAC process. I know there is
19 many more processes, including, you know, public
20 discussion and the forums.

21 A I think to begin with it -- we have to
22 remember that we have got a very, very major
23 devastating accident at hand here which, frankly, in my
24 experience with the ARAC process, we are not always
25 equipped with that close and meaningful a purpose.

1 Secondly, there has been quite an educational
2 process going on in the industry, beginning with the
3 flammability conference, and certainly with this
4 hearing, which has been very, very informative for me.
5 I think as we develop that information, the better we
6 develop it when we go into the ARAC process, it clears
7 away a lot of those obstacles.

8 Finally, the FAA has taken the initiative to
9 put at least that process on a six month time line,
10 which is something they haven't done before, and I have
11 been involved in the ARAC process for several years, as
12 you may be aware, with in flight icing, and have
13 experienced the frustrations of that.

14 I think this is maybe a little bit of a
15 different approach that they are taking now.

16 **Q** Thank you. I just have one final question,
17 and it has to do with testing. What is needed? What
18 is the key part in a lot of what you express are
19 concerns? Is it the reliability of the system, that it
20 is properly designed and it does not contain inherent
21 failure modes?

22 That is one thing that was brought out I
23 think yesterday, but perhaps not emphasized in this
24 context, and that is that a system once proposed and
25 even shown to function is not ready to be put on an

1 aircraft or a fleet, but money must be expended for
2 testing. In some cases the more complex the system the
3 more money must be spent, and I suppose that will be
4 one of the drivers.

5 Do you feel that this is something that
6 should move ahead on an accelerated schedule?

7 A We certainly do. I mean, I can't
8 overemphasize our feeling that there is a need to do
9 this sort of thing. We generally don't approach this
10 from a financial side of the house, because we are
11 obviously not paying any of the bills. But, we do have
12 to keep in mind that somebody is, and we do have to get
13 it done.

14 We are really interested in a solution, and
15 we are also interested in making sure that we don't
16 engage in something that is so costly that it becomes
17 almost un-doable. So, we need to keep it all in
18 balance, but we do want to accelerate this work.

19 Q Yes, sir. My final point there would be
20 would it not be meaningful and important to at least
21 conduct some testing to resolve some of the questions
22 that arise during the ARAC so that their final results,
23 if you will, are informed and based on more factual
24 information?

25 A I think that is definitely a need. In fact,

1 the more information we have going into the ARAC
2 process, the better that would work. I think that Mr.
3 McSweeney made a good point earlier when he said that
4 the Safety Board was engaged in a lot of the testing
5 that will be meaningful on a number of fronts.

6 Not just flammability, but, as I said
7 earlier, the investigation that Mr. Swaim had
8 conducted, and the more that information is shared
9 throughout the civilian side of the industry between
10 FAA and NTSB and the manufacturers and ATA and AIA and
11 so forth, I think the more effective that ARAC is going
12 to be.

13 If we can go in with completed work with some
14 reasonably sound, fundamental conclusions, then we
15 don't have to spend a lot of time in the ARAC wondering
16 whether we need to be doing this or not, or whether Dr.
17 Shepherd has actually completed his work, or whether it
18 has been appropriately criticized and found to be sound
19 and so forth and so on, which is the kind of thing that
20 threatens to take place if we are not careful with it.

21 Q I understand. Is there any other remarks
22 before we go on to another subject from you, Captain
23 Green?

24 A I think the only thing that I would offer in
25 addition is, as I said, we were interested in the fuel

1 concept, and I was also very interested at the
2 flammability conference in what Dr. Shepherd had to say
3 about the affect of temperature on the minimum ignition
4 energy.

5 I think that is a significant player. The
6 temperature control approaches probably should not be
7 overlooked, particular in the short term because they
8 may be an easier approach in the short term.

9 But, other than that we plan to be very much
10 involved in this and stay involved, and hopefully
11 provide a little bit of a semi-independent perspective
12 in the ARAC and other areas, because we are not a
13 manufacturer and we are not an operator and we are in
14 the airplane quite a bit more than anyone else. So, we
15 have kind of a vested interest here.

16 Q Thank you.

17 CHAIRMAN HALL: Dr. Shepherd, Captain Green
18 was paying attention, so —

19 DR. SHEPHERD: That's good to hear.

20 CHAIRMAN HALL: so, now I just -- I think
21 what I would like to do is see now if we could take a
22 break. We will take a little longer break than normal,
23 come back at 11:00, and then we will see if we can't
24 complete this hearing by 1:00 p.m.

25 I don't want to rush anything. I want the

1 parties to have whatever time they need to ask their
2 questions and -- and, so, we will try to be --
3 summarize up here, but we want to be sure we cover the
4 subject well.

5 But, that will be what we will attempt to do.
6 so, we will stand in recess until 11:00.

7 (Whereupon, a brief recess was taken.)

8 CHAIRMAN HALL: We will reconvene this public
9 hearing of the National Transportation Safety Board
10 which is called for the purpose of looking into the
11 accident investigation of TWA 800.

12 Mr. Anderson, would you like to proceed?

13 MR. ANDERSON: Thank you, Mr. Chairman.

14

15

16

17

18

19

20

21

22

23

24

25

1 FURTHER DIRECT EXAMINATION

2 BY MR. ANDERSON:

3 Q Mr. McSweeney, on a different subject, we
4 heard during an earlier testimony two days ago a Boeing
5 witness talking about the standards that they used for
6 protecting the -- I believe it was bonding protection
7 of the fuel tank area. That would be in respect to
8 preventing static electricity build-up and also arcing
9 from stray electrical voltages.

10 We heard that the specification that was used
11 was a military specification, and I think that we also
12 heard that that specification was in the process, or
13 actually had been cancelled by the Department of
14 Defense.

15 We also understand that the Department of
16 Defense, as a matter of policy, is canceling many of
17 the specifications that, like this one, will affect the
18 design of new aircraft.

19 Could you tell me what the FAA is doing to
20 assure that this information -- and that is what the
21 specifications in general represent -- is accumulated
22 experience and guidance to assure that this information
23 is being maintained and updated for the purposes of
24 insuring the integrity of the commercial aviation
25 fleet?

1 A I will be more than happy to. There are
2 several bodies, SAE being one, who have taken on the
3 challenge of the mil specs of being obsolete to pick up
4 some of those mil specs and make them industry
5 standards.

6 I happen to be a member of the Aerospace
7 Council of SAE. That is the body that basically
8 manages the cooperative engineering program which
9 produces all of those standards and specs.

10 We have been, over the last -- I think it is
11 about three years, regularly briefed on the progress of
12 converting those into SAE standards. Certainly, the
13 material in those needs to be retained and improved and
14 modified.

15 There really is a process by which SAE
16 standards are updated on a regular basis. This
17 particular effort is to just take the mil standards
18 verbatim and move it into an SAE standard.

19 I believe there are other standard-setting
20 bodies that are trying to do the same thing, and we are
21 a part of that because we are on a lot of the teams
22 that help develop those standards.

23 Q Yes, sir, I understand. In addition to that,
24 to just further clarify it, you are talking about one
25 route where a standard which is being cancelled is

1 passed to an engineering society, would that be correct
2 to say, that you mentioned?

3 A Yes, I would call SAE an engineering society.

4 Q I would ask you if in your opinion the -- all
5 specifications should follow that route, or should
6 there be specifications that perhaps should remain
7 under government control?

8 A Oh, I don't think I am an expert to talk
9 about what the military's needs might be and what
10 should be under government control and what shouldn't.
11 I think the real focus of the FAA is our rules and
12 regulations, and most of our rules and regulations
13 provide for a level of safety that we are trying to
14 achieve.

15 It is up to the manufacturers to, using
16 whatever means and methods they believe are
17 appropriate, show us that they do, in fact, meet that
18 level of safety that we have identified.

19 I think there is a very good argument that
20 the burden of maintaining those industry standards
21 ought to be borne by the industry, not the taxpayers of
22 the United States.

23 Q When we use the term "standard," don't we
24 imply that everybody is following the same script, so
25 to speak?

1 A You have to, I think, understand the
2 difference between the military use of standards and
3 the civil use of standards. Standards are acceptable
4 to the FAA. There are ways of doing business.

5 Certainly there is a benefit to having an
6 industry standard. It is -- there is certainly a
7 benefit to everybody to have people doing things the
8 same way. That is fairly much the case in engineering,
9 because there is not a multitude of solutions to a
10 given engineering problem. There is usually very few.

11 I am not an expert in the military, and maybe
12 some of the other people on the panel can address this,
13 but in the military case the military is also the
14 purchaser, and some of the standards I believe are used
15 to make sure that the military gets the product that
16 they, as the purchaser, are paying for.

17 I would say having spent some time on the
18 other side of that military civil equation working at
19 Northrup Aircraft I am at least familiar with some of
20 the standards that dealt with flutter vibration and
21 acoustics which was the area I was working in.

22 I am not an expert, though, in that.

23 Q I understand. I really have two other
24 questions in that area, though, and that is, who in the
25 FAA is monitoring this process and making sure that

1 cancellations do not affect your regulations.

2 In other words, I think we can find instances
3 where the most either specifications or standards are
4 cited as possible or acceptable means of achieving a
5 goal.

6 A Well, if a mil standard that has been
7 cancelled is an acceptable means of compliance with a
8 regulation, the fact that it has been cancelled
9 wouldn't change that fact. The real issue, is the
10 process contained within that mil spec one that still
11 is appropriate for a particular regulatory compliance.

12 Q My -- I believe my point would be, sir, that
13 if the specification is not being reviewed by a
14 competent technical authority within the FAA, perhaps
15 the specification becomes obsolete or inappropriate.

16 A Well, you have to remember that we review
17 every application of a standard during type
18 certification of a product. Well, every -- in the
19 sense that the ones that are really critical to the
20 design, because some we delegate to the designees to
21 review in our behalf.

22 so, if there were a standard that were
23 heretofore acceptable for use on an airplane, and the
24 design of that airplane was so radical from previous
25 designs, that would cause us to look at the continued

1 applicability of that standard. So, we do, in fact, on
2 a regular basis look at them.

3 Q I understand, and the last point I would want
4 to ask you about is that looking at the options
5 available here, which are of course the DOD can -- is
6 no longer funded to maintain these documents, and
7 therefore the only alternatives are other government
8 agencies or the public, the commercial public or the
9 engineering societies.

10 The question I would ask you is, who will pay
11 for this effort?

12 A For the SAE effort that is ongoing, and it is
13 a very significant effort, the government, I believe.
14 The FAA is now contributing \$85,000 a year to the SAE
15 Cooperative Engineering Program. From that we figure
16 we get millions of dollars of benefit, because many of
17 their standards are referenced in our technical
18 standard orders.

19 I think it is also important to point out
20 that for military aircraft that are carrying passengers
21 only, and even for some of their training aircraft,
22 they have chosen to accept the FAA standard.

23 Q Thank you. I think it is a very important
24 point, and I am glad to hear that there is provision
25 for maintaining these one way or the other.

1 The next thing, Mr. McSweeney, that I wanted
2 to cover is basically the -- we had talked about it
3 just a little bit earlier, which was the FAA solicited
4 public comments.

5 Could you give us just an overview from your
6 point of view personally of what you were attempting to
7 do by asking the questions in terms of -- you probably
8 felt that you would get both technical information and
9 opinions. Could you just, you know, clarify that a
10 little bit?

11 A Well, when we issued the notice to get
12 comments on the NTSB recommendations we had several
13 objectives. First was we wanted to obtain answers to
14 specific questions. Those specific questions are in
15 the notice.

16 But, we also wanted to frame as best we could
17 a background of history so that when those questions
18 were answered there was some framework around which we
19 would get those answers.

20 so, we also included things in our notice of
21 what we felt the published information was on fuel
22 properties, what the FAA had done in the past about
23 explosion hazards, past activity in nitrogen inerting
24 by the FAA, complete history to what we had of civil
25 and military accidents, and we realized we would get

1 both very good factual data and we would get a lot of
2 opinions, as well.

3 We did receive over a thousand pages of
4 comments. There was comments from the general public,
5 comments from academia, comments from manufacturers,
6 operators, et cetera, other safety organizations like
7 the FAA, and clearly some of those had opinions and
8 some of those had some substantive data to I think help
9 in the debate of this whole subject, whether it be in
10 the FAA arena, or in an arena like this.

11 Q I understand. The length of the document
12 that went out for -- and we have entered it in the
13 record. It is about twenty-two pages. It is an
14 excellent coverage, I believe, of the major issues
15 involved and the complexities.

16 What I would like to just ask you a little
17 bit now about in that document, which I know that you
18 are generally familiar with, is the history which, as
19 you have alluded to, the FAA has said in this document
20 that some of the testing goes back to the 60's.

21 We get up to 1971 and I quote, "NTSB
22 recommendation A 71-59 requested action to require fuel
23 system fire safety devices which will be effective in
24 prevention and control of both in flight and post-crash
25 fuel system fires." It goes on to explain the action

1 and the considerations that were done in that time
2 frame.

3 Were there any reports, or any formal
4 engineering documents that came forward from that time
5 frame that would be available?

6 A I don't -- I guess I can't recall specific
7 ones off the top of my head now. I do remember
8 extensive documentation of the anti-misting kerosene
9 program.

10 Q Just quickly, the other question I have is --
11 reading on it says in 1972 the FAA document informs us,
12 "the Aviation Consumer Action Project Petition for Rule
13 Making requesting action to require nitrogen fuel tank
14 inerting systems on all transport category airplanes, "
15 and based on these requests the FAA issued Notice of
16 Proposed Rule Making Number 74-16.

17 The final note we are getting here at the
18 comments received from the public on that Notice of
19 Proposed Rule Making opposed this proposal because it
20 was argued that the explosion prevention system would
21 have little or no effect on reducing the fire and
22 explosion hazards of impact survivable accidents.

23 Did that also include the NTSB'S concern
24 about the in flight phase?

25 A Well, as I said before, that particular

1 effort and what is referred to as the Safer Committee
2 which was a full advisory committee that met for a
3 couple of years, I believe -- and it, by the way, has
4 tons of documentation.

5 They looked at -- after the notice went out
6 they looked at the history of accidents. My
7 recollection is that at that point they concluded that
8 there wasn't an in flight history as significant as
9 there was of a post crash fire history.

10 so, they believed the most appropriate thing
11 to do at the time was to create a post-crash fire
12 scenario as the scenario, or as the goal that everybody
13 was trying to protect against. Quite frankly, I think
14 we have been fairly effective in doing that.

15 Q Yes, sir. Essentially what has happened is
16 that there is new information and new experience
17 contributed since that time, would you agree, to
18 somewhat change our view of these incidents?

19 A Well, I think I clearly made that statement
20 earlier in this testimony that our opinion of the
21 past -- and it is just like anybody else -- our opinion
22 of the past is certainly likely to be different today
23 than it was back then, and we have gone on the record
24 many times to say everything is on the table, including
25 nitrogen inerting.

1 Q I understand. This gets me to the next area
2 that you commented on. I know it is an important
3 subject, so I wanted to ask you several questions in
4 the area of fuel selection.

5 The NPRM talks about the use of JP-4 during
6 the earlier time period in the late 60's and early
7 70's, and it was believed because of what we now know
8 is the flammability characteristic, so that may have
9 been a major factor in some of the earlier accidents.

10 Could you comment on that and give us your
11 opinion?

12 A Yes. When you look at -- at least when I
13 looked at the history of the accidents, they tend in my
14 mind to group into three clumps. The first clump was
15 JP-4 . It certainly is a different fuel than used
16 today, and we all know what its flammability parameters
17 are.

18 The second kind of group of accidents is
19 external threats to the airplane, and I was happy to
20 see that the Board even broke it up as external and
21 internal threats because I think they are possibly --
22 you might be able to look at solutions differently
23 whether it is an external or internal threat.

24 Then the third group was the internal threat.
25 In the internal threats I would say that probably the

1 history that is most significant is the history with
2 Jet-A fuel.

3 Q How would you carry that forward today in
4 your evaluation of the JP-5 versus those other fuels,
5 JP-8, Jet-A-1, Jet-B? Is there some way that you can
6 draw a line between those as safe, safer, safest?

7 A Well, certainly the JP-5 fuel offers
8 advantages in solving the flammability of ullages, and
9 it makes that much easier to solve if you are using JP-
10 5 fuel. Quite frankly, if you --

11 CHAIRMAN HALL: Does it cost more at the
12 pump, Mr. McSweeney?

13 WITNESS MCSWEENEY: From the statistics, the
14 data that I have from the military, the difference
15 between JP-5 and JP-8 -- JP-8 is equivalent to Jet-A --
16 is two pennies.

17 Now, the fuel cost itself is much higher, so
18 you can't just look at the price per gallon because
19 there are reasons having to do with how it is delivered
20 to the source that make it a little bit more expensive.

21 But that the JP-5 is presently produced in
22 very small batches, and what we have to look at when we
23 deal with the ARAC group and what we want the American
24 Petroleum Institute to look at is, what is that cost
25 likely to be if it actually replaced all of the

1 millions and billions of gallons of Jet-A that we use
2 today?

3 The price is not trivial, but is also is not
4 enormous, and we just -- it is just something we have
5 to look at.

6 Q The last thing I want to talk about with the
7 NPRM's comments was the itemization of the accident
8 record both in the commercial world and in the military
9 world, and as I look through that with the caveat that
10 was given in the NPRM, that many of these were related
11 to the use -- or thought to be related to the use of
12 JP-4 fuel.

13 We count thirteen commercial accidents from
14 the early 60 -- well, actually, the earliest being
15 1959, and on the military side of non-combat airplanes,
16 which in this case are two types. One is the Boeing
17 707 and the other is the B-52-H which were both
18 manufactured by Boeing.

19 Could you comment on that list in terms of
20 what, if anything, that signifies? Is there anything
21 that the FAA suggests, any trend?

22 A Well, maybe I was trying to look at the
23 table, but I didn't quite understand what significance
24 you are trying to get me to comment on.

25 Q Well, we have heard -- there has been a lot

1 said and written about the probability of fuel tank
2 flammability occurrences, and I think this listing --

3 CHAIRMAN HALL: If I gather it, it is the
4 issue of the change in the fuel having impact on the
5 number of accidents. When you went from -- what is
6 that jet?

7 MR. ANDERSON: JP-4 .

8 CHAIRMAN HALL: JP-4 to Jet-A.

9 MR. ANDERSON: Yes.

10 WITNESS McSWEENEY: I think in the general
11 sense you can get a trend like that out of that data.
12 But, you have to really go back and look at each and
13 every accident. Some of the fuel tank explosions were
14 maintenance induced. I don't think you should in any
15 way count that as an issue relative to one kind of fuel
16 or another.

17 One was a boost pump that was put in a tank
18 where the wiring was actually put in the tank. Well,
19 you know, you can't say that that was a problem with
20 the fuel. It was a problem with the maintenance. So,
21 you really have to go back and look at it.

22 I think the real key is not to look that much
23 at the past, but recognize we had a tragic accident and
24 we need to make sure we never have another one.

25 CHAIRMAN HALL: Excellent.

1 MR. ANDERSON: Thank you, sir.

2 BY MR. ANDERSON: (Resuming.)

3 Q My last question would be, could you share
4 with us some of your impressions, rather than going
5 through individual responses -- but, we can do that if
6 you like -- to your NPRM. Could you just share with us
7 your feelings on what was received? -- and feel free to
8 give examples if you like.

9 A Okay, as I said, there were about a thousand
10 pages of comments. We received comments from the
11 industry, nitrogen inerting, system manufacturers,
12 foreign regulatory authorities, universities and such.

13 There was admittedly a lot of people who
14 though there wasn't even a problem that needed to be
15 solved, and there were others that thought we should go
16 well beyond what we were doing right now. So, there
17 was a full gamut of comments, which I think is very
18 positive. I mean, that is the kind of input we like to
19 get.

20 There was comments about temperature,
21 controlling the fuel -- temperature, comments about
22 ventilating, insulating the tanks, nitrogen injection
23 to cool the fuel on the ground. There was a lot of
24 comments received about nitrogen inerting. Quite
25 frankly, those people that had a system felt their

1 system was the right system to use. We are certainly
2 going to have to look at that and see if we agree with
3 that.

4 But, things like nitrogen, OBIGS and
5 cryogenic liquid comments were received. CO₂, dry ice,
6 charcoal generation generators were used -- were
7 submitted as comments. Increasing the flashpoint of
8 fuel was submitted as comments.

9 so, in a general sense we really, I think,
10 got the breadth of comments that we were looking for.
11 I think we got the depth to make a decision that there
12 are solutions out there, and what we are asking ARAC to
13 do is give us specific -- first, by regulatory
14 criteria, and then that has to be based on specific
15 known ways of getting there.

16 so, we think it is not a unique thing that we
17 have issued comments, or asked for comments and NTSB
18 recommendations, but I don't think you can count the
19 number of times on more than one hand that I am aware
20 of.

21 But, in this particular case, the comments we
22 received -- and I think it was alluded to before -- the
23 comments from the U.S. -- well, I shouldn't say just
24 U.S. industry because it was more than that, but from
25 the manufacturers and the operators, far exceeded my

1 expectations .

2 Q Thank you, Mr. McSweeney.

3 MR. ANDERSON: Mr. Chairman, I have no more
4 questions.

5 CHAIRMAN HALL: Well, I think we will move to
6 the party table, unless there are any of the Technical
7 Panel . We will give the Technical Panel a chance after
8 we go through the parties. In fairness, let's go down
9 to the parties.

10 I believe we begin with Mr. Liddell, the
11 International Association of Machinists and Aerospace
12 Workers.

13 MR. LIDDELL: Thank you, Mr. Chairman. I
14 just have a couple questions for the military
15 representatives . In regard to the foam use, has -- is
16 there or has there been any summary or records made of
17 maintenance problems with the use of foam?

18 MR. LAUZZE: I am not personally aware of any
19 detailed history of it, but we could look into it.
20 But, I am not aware of one.

21 MR. BALL: That is really out of our realm.
22 These gentlemen are testers and I am an educator, and I
23 have heard comments, as we heard yesterday, that it is
24 removed for maintenance problems.

25 If I were a pilot and I was going to go into

1 combat and heard the maintenance offer removed my foam
2 before I flew in there, I might be a bit upset about
3 it. So, I think you have to look at the maintenance
4 versus the survivability issue from our perspective.
5 But, it really is -- it is not something that we are
6 familiar with.

7 MR. LIDDELL: Also, are you familiar with
8 what type of fuel tanks this foam is used in? Is it in
9 a bladder tank, or is it just a fuel tank?

10 MR. BALL: Most of the foam is in the wing.
11 Most of the foam applications are in the wing tanks.
12 There are some applications in the fuselage. The F-15
13 is in the fuselage, and I believe the F-15 fuselage has
14 a bladder.

15 But, generally speaking, the foam is most
16 applicable to us in the wing tanks because that is a
17 large, exposed area. That's a (inaudible) mentioned
18 yesterday, and those wings take a lot of hits.

19 Also, those wings -- that wing field is,
20 generally speaking, used first. So, that is our most
21 vulnerable area. That also gives us a minimum fuel
22 penalty because we don't carry that much fuel in the
23 wing.

24 MR. LIDDELL: Thank you very much. No
25 further questions, Mr. Chairman.

1 CHAIRMAN HALL: Thank you very much. Trans
2 World Airlines, Inc. Captain?

3 CAPTAIN YOUNG: Thank you, Mr. Chairman. At
4 this time, no questions from Trans World Airlines.

5 CHAIRMAN HALL: Thank you very much. The
6 Federal Aviation Administration? Mr. Streeter?

7 MR. STREETER: Yes, Mr. Chairman. For Mr.
8 Tyson and maybe also for Mr. Lauzze; on the reticulated
9 foam, again, is reticulated foam being used in any new
10 installations, or is it being supplanted by the OBIGS,
11 or how is that going right now?

12 WITNESS TYSON: Yes, it is used in new
13 installations . The latest upgrade to the Navy F-18 --
14 FA-18, the EF version is using reticulated foam in the
15 wings .

16 MR. STREETER: Okay. Has the product itself
17 changed over the years? -- and I am speaking of the
18 composition of the product for whatever purposes.

19 WITNESS TYSON: Yeah. I think the answer to
20 that is yes, but my aspect of it, it is testing what
21 they give me as opposed to designing it.

22 MR. STREETER: I see.

23 MR. BALL: Yes, if "over the years" you mean
24 since 1965, the answer is yes.

25 MR. STREETER: Oh, definitely.

1 MR. BALL: It is significantly changed.

2 MR. STREETER: Yeah, yeah.

3 MR. BALL: Also, there is a study of pore
4 size versus solid content, and we have gone from the
5 polyesters which broke down to the polyurethanes which
6 do not break down.

7 In the F-18 the wing's skin is literally
8 bolted -- or, attached -- and they don't want to take
9 that off, and this foam is in there and it is going to
10 last, as we hope, for a significantly long time.

11 MR. STREETER: Okay, and that -- that was
12 really the issue I was after. There were situations
13 with the earlier product where there was break-down, is
14 that correct?

15 MR. BALL: Yes. I wasn't there at the time,
16 but that is what I heard.

17 MR. STREETER: And the impression is that
18 that has been addressed with the later product
19 improvements?

20 MR. BALL: Switching from the polyesters to
21 the polyethers.

22 MR. STREETER: Okay. Then, I guess for Mr.
23 Anderson, I would have a question in that I believe Mr.
24 Anderson stated that he had a letter, or some
25 information from McDonnell Douglas indicating that they

1 had removed material from an F-4 which showed no
2 deterioration, and yet in questioning from the Board
3 Mr. Liddell responded that material had been removed
4 from an F-15, and I believe that involved some
5 deterioration, although I am not certain.

6 Is there some way we can look into this,
7 because it appears that the later airplane is the one
8 that has the deterioration, and the earlier airplane
9 didn't.

10 MR. LAUZZE: Are you referring to me, sir?

11 MR. STREETER: Yes, sir. I was wondering if
12 we could possibly look into the information that came
13 out from these two pieces of testimony to see if we
14 could find out whether there is the situation.

15 DR. LOEB: Mr. Streeter, I can answer that.
16 We definitely will.

17 MR. STREETER: Okay, thank you very much,
18 sir. For Mr. Tyson or Mr. Lauzze, do you know if the
19 Air Force has used reticulated foams in any large air
20 frames?

21 MR. LAUZZE: Yesterday I believe I referred
22 to the C-130. The Navy is using it in the P-3. I
23 think those are probably the two largest systems.

24 Going back to one of your earlier questions
25 on new aircraft, the Air Force is in the process of

1 buying the C-130 J. It is going to be in the C-130 J,
2 a brand new system.

3 Going back to the other question on the F-15,
4 the earlier versions of the F-15 use the polyester foam
5 that Bob referred to earlier, which did have a
6 hydrolytic stability issue. It has since been switched
7 over to polyether, and that degradation issue has
8 pretty well gone away.

9 MR. STREETER: Okay, so it really is a
10 product type of situation that you have to deal with?

11 MR. LAUZZE: Yes, sir.

12 MR. STREETER: Okay. Again, for either Mr.
13 Lauzze or Mr. Tyson, the discussions on OBIGS. You had
14 some schematics up there that I felt gave a fairly good
15 break-down of how the system worked, but it doesn't
16 give me -- never having worked with one of those, it
17 doesn't give me a reference as far as weight or size.

18 Is this a large -- physically large system,
19 or heavy, or what does it entail in the aircraft?

20 WITNESS TYSON: It really depends on how you
21 interface it to the airplane. I can give you -- and I
22 am going to be drawing deep into my memory for some of
23 this .

24 I can give you some numbers for tactical
25 airplanes. If I am remembering correctly, a retrofit

1 system on an existing airplane has quite a bit of
2 penalty associated with it. I want to say on the order
3 of 1,000 pounds.

4 Now, you have got to remember that tactical
5 aircraft has some incredibly high gas demands when it
6 does its climbing and diving to keep the ullage of the
7 fuel tanks inerted. The transport aircraft don't have
8 that same high demand as a result of the new grade, but
9 they have larger tanks.

10 A system I am aware of that was designed
11 along with the design of the fuel system weighed on the
12 order of 100 pounds.

13 MR. STREETER: That was initial design? In
14 other words, went into initial production with the
15 aircraft? Is that what you are saying, or retrofit?

16 WITNESS TYSON: The aircraft program was
17 cancelled.

18 MR. STREETER: Oh, okay. So, then, there
19 appears to be a trade-off between the tactical demands
20 and the capacity between your tactical aircraft and
21 your -- is there a possibility that a similar size
22 system could be used in a much larger aircraft in a
23 transport category?

24 WITNESS TYSON: Ralph might be able to add
25 some more to that, because they have the larger

1 aircraft that have been protected. But, certainly the
2 larger fuel tanks would demand a larger system than a
3 100 pound system.

4 MR. STREETER: Okay, understood. How about
5 the -- is this a high maintenance system, is it a
6 system that requires servicing every time it is on the
7 ground, or a calendar servicing, or what?

8 MR. BALL: I will step in here and excuse
9 these two gentlemen. They are testers. They basically
10 determine the effectiveness of the system and the size
11 of the system that is necessary.

12 The design of the system for reliability,
13 minimum impact on maintenance, minimum impact on other
14 aspects of safety is really not something that we are
15 aware of. I apologize for that.

16 MR. STREETER: Okay, understood. Do you have
17 any background on operational requirements? Is it a
18 system that requires pilot input, or is it a passive
19 system, or do you know?

20 MR. BALL: Again, sorry, we don't know.

21 MR. STREETER: Okay, understood, sir. Again,
22 let's try another line here. Again, I understand that
23 you may not have this, but I am -- there was -- you
24 gave us a list of various tactical and transport
25 aircraft that carried the systems.

1 Does either the Air Force of the Navy use
2 some type of inerting system on board all their
3 transport category aircraft?

4 MR. LAUZZE: The answer is no.

5 MR. STREETER: Okay. What -- or, if you are
6 aware of it, what kind of factors go into the decision
7 as to whether or not a system would be put on an
8 airplane?

9 MR. LAUZZE: I can't really speak to some of
10 the systems that don't have protection. Many of them
11 were designed long before I, you know, was involved
12 with the Air Force. But, with any design, you know,
13 you need to look at what the -- particularly in the
14 military, you need to look at what the mission is, what
15 its predicted exposure rate is, what the threat is.

16 You know, is it going to come up against
17 missiles, is it going to come up against gunfire, is it
18 never going to see combat? All those things play into
19 the equation, and obviously, you know, we want an
20 optimum low weight solution.

21 so, there is no single answer, and I think
22 that is one reason why we see things like foam, we see
23 things like Halon, we see things like liquid nitrogen,
24 as well. We need a whole bag of tricks, because
25 everything -- you know, each system is different.

1 MR. STREETER: In the list you showed up
2 there, I noticed that the -- you had both the C-130 and
3 the C-5 listed as having protective systems, and if I
4 understood correctly the C-5 was a retrofit due to
5 situations it had run into on the ground.

6 The C-141 wasn't listed, and since it sits
7 right in between the two, I am wondering if there was
8 some reason that -- or, does it have a system, and if
9 it doesn't, what is the reason it doesn't?

10 MR. LAUZZE: That was a system I was
11 referring to as the answer to the earlier question. I
12 really don't have any knowledge on the 141
13 specifically. It has been around for a long time. I
14 really can't speak to it.

15 MR. STREETER: Since we are dealing with a
16 Boeing product here, although we are dealing with a
17 concept that covers everybody's product, and I believe
18 while I am not sure I have all the designators right,
19 so I will stick with the civilian designator, but I
20 believe the Air Force is using the 747 for command and
21 control purposes, 707 derivatives for various AWACS and
22 theater operations and so on, and the 737 for
23 navigation training and personnel transport.

24 Do you know if any of those systems have
25 inerting aboard?

1 MR. LAUZZE: No, sir, I do not.

2 MR. STREETER: I guess for the Navy the
3 equivalent question on the C-9, or -- well, actually
4 for the Navy and the Air Force both, the C-9?

5 WITNESS TYSON: I have no idea. I am with
6 tactical airplanes.

7 MR. STREETER: I understand. Okay, thank
8 you, sir.

9 Mr. Thomas, you mentioned -- I believe you
10 said in the triple seven that there is a sonic
11 transducer that is used now for fuels?

12 WITNESS THOMAS: For fuel (inaudible),
13 correct.

14 MR. STREETER: Okay. Now, even though you
15 said that system has wiring in the tank, my presumption
16 would be, based on my understanding of a system like
17 that is that this system would also be immersed for the
18 majority of the time it is operation, wouldn't it?

19 WITNESS THOMAS: Yeah, the sensor itself is
20 at the bottom of -- each position we have multiple
21 sensors out along the wing and in the center wing tank.

22 MR. STREETER: Okay. So, unlike the capacity
23 probe system, you shouldn't have any wiring that is
24 necessarily exposed to vapors?

25 WITNESS THOMAS: I can't say that, because

1 obviously as the tank empties the wiring and eventually
2 the sensors will become exposed.

3 MR. STREETER: Okay, would you --

4 WITNESS THOMAS: The wing has a dihedral.

5 MR. STREETER: Oh, correct.

6 WITNESS THOMAS: As the fuel drains in board,
7 the outboard sensors will eventually become uncovered.

8 MR. STREETER: Okay.

9 WITNESS THOMAS: But, the system is designed
10 for exactly the same load --

11 MR. STREETER: Same function?

12 WITNESS THOMAS: -- requirements as we have
13 described in the capacitive type of systems.

14 MR. STREETER: Okay, and is it -- since it is
15 a bottom-mounted system, is it a fair assumption that
16 there is far less wiring exposed inside the tank?

17 WITNESS THOMAS: I can't answer that question
18 without actually doing the details, looking at that
19 system.

20 MR. STREETER: All right, thank you, sir.
21 That is all I have, Mr. Chairman.

22 CHAIRMAN HALL: The Boeing Commercial
23 Airplane Group? Mr. Rodrigues?

24 MR. RODRIGUES: Yes, Mr. Chairman. First, to
25 answer one of Mr. Streeter's questions, the C-17 system

1 weighs 2,000 pounds.

2 One question for Mr. Thomas. The Chairman
3 asked the question earlier on, what work Boeing has
4 done so far since the TWA accident. Could you respond
5 to that now?

6 MR. THOMAS: Yes, certainly. I believe the
7 question was two-part, what service bulletins we had
8 published and what additional work is going on. As far
9 as service bulletins, there is a fuel pump conduit
10 service bulletin which is the inspection the FAA
11 mandated through an AD. That is in your docket, I
12 believe, at this point.

13 We have the scavenge pump connector service
14 bulletin, we have the series three terminal block that
15 we discussed at length. That is -- as we said, is due
16 to be released in January/February of next year.

17 We have the center wing tank inspection
18 bulletin which is also in the public docket. That was
19 released in -- the updated revision is going to be
20 released in January of '98.

21 Another one which is not connected directly
22 with TWA 800 is the override boost pump connector
23 inspection design improvement service bulletin we
24 released simply because we had a connector problem. I
25 believe that is also in the docket.

1 We discussed a little bit on -- I think it
2 was -- I am not sure which panel it was. I believe it
3 was the Monday panel. We kind of ran through things
4 that we are doing.

5 I want to make a point here that -- I guess
6 Mr. McSweeney made the point earlier. We have a very
7 large fleet of airplanes that is out there. There is
8 13,000 airplanes out there in the fleet. 9,000 of
9 those, or more than those are now Boeing products as a
10 result of the merger.

11 We really need to look at ways to reduce
12 flammability, as we said in that Monday discussion. We
13 need to work on that. We need to make sure that the
14 system is retrofitable in a relatively easy fashion.
15 The simpler, the better, if you will, the KIS
16 principle.

17 JP-5, as I said earlier in the discussion,
18 was one of the obvious extensions of that. If you move
19 the flammability over and if you are focused on tank
20 flammability, that is an obvious thing to go after.
21 Center wing tank cooling; we discussed it at length in
22 discussions with the NTSB.

23 We flew -- when the NTSB was flying the
24 Evergreen airplane, as was discussed a couple of days
25 ago, we took the opportunity to fly three flights of

1 our own, piggy-backing onto that experience using the
2 flight test and all the instrumentation.

3 We used that flight test data to build a
4 computer model. In fact, we have now two computer
5 models that we can use first of all to cross check how
6 well the models are behaving, but also to study all of
7 these things. So, we are very actively looking at
8 those.

9 If you look back in the response to the FAA
10 back in August, one of the things we did say was the
11 insulation concept would look very promising, and we
12 were continuing to work on them. We are still doing
13 that work. We use the flight test data. We are now
14 looking at concepts of slot cooling, as I think I
15 described briefly on Monday.

16 We are also doing laboratory testing of
17 ullage sweeping. That is a very simple concept. It is
18 very appealing in terms of trying to blow air into the
19 tank. The issue really is what do you do with the
20 light ends that get blown overboard, or is there some
21 way of collecting them somehow, and that is the next
22 step we want to go to.

23 The other point that I think is very
24 important is we are designing - we are reviewing our
25 designs on the bonding and grounding issues as we try

1 and create the service bulletins.

2 We are going through all our airplanes very
3 carefully to look at all the bonding and grounding
4 requirements we have imposed on the airplane to see
5 that they are correct, first of all, and to make sure
6 we want -- then we go out and look and create the
7 service bulletins on each of the airplanes so we have
8 the right measurements.

9 so, it is -- the very act of creating the
10 service bulletins is forcing a design review. It is an
11 interesting process. We have to go through drawing
12 after drawing, and going through a 737 that is --
13 whatever it is, almost thirty years old, to pull out
14 all those drawings and look at very carefully how we
15 created the bonding design in those airplanes and then
16 invent and create a test in the service bulletin, that
17 is really why the 747 service bulletin is a hundred
18 pages long. There is an awful lot of work going into
19 that service bulletin.

20 In regard to all the questions on the -- and
21 going back to your question earlier, Mr. Chairman, on
22 the military side of the house. As I said earlier, we
23 had our own military people involved in this. We have
24 also talked to the foam manufacturers, we have talked
25 to the inerting manufacturers.

1 So, we -- and most of this is in the response
2 to the FAA. I think there is an awful lot of very good
3 work that was done by the industry. We discussed the
4 weight of foam, we discussed the design of the fuel
5 tank inerting system. I was involved i that.

6 It was very important. I think we spent a
7 lot of time doing trade studies. We weren't simply
8 putting a system together to get a rough weight. We
9 actually did a lot of design trade.

10 We spent a month and a half doing design
11 trades on the size of the gas separator unit versus the
12 compressor system that we needed to feed it, because
13 some people were saying, well, if you just fed the air
14 into the gas separation unit it would be a very simple
15 thing to do, it would be very reliable.

16 Yet, the weight of the gas system went up
17 phenomenally because of the low pressures available.
18 so, then you trade that against the compressor cooling
19 system required to feed the gas separation system the
20 correct pressure and temperature.

21 What we have in this document is that
22 optimized system, and it still weighs something like
23 2,000 pounds. We used a lot of the C-17 experience in
24 that, by the way. So, I would refer you to the
25 document for a lot of this information.

1 CHAIRMAN HALL: Well, thank you. That is a
2 very complete response. Thank you very much.

3 MR. RODRIGUES: No additional questions, Mr.
4 Chairman.

5 CHAIRMAN HALL: The Air Line Pilots
6 Association? Captain?

7 CAPTAIN REKART: Yes, sir. I think the first
8 question would be for Mr. Lauzze and Mr. Tyson.
9 Yesterday in your presentation you used terms like
10 "successful" and "effective" when referring to
11 different remedial systems, reference being made to
12 successful use of inerting and the fact that foam had
13 been effective.

14 Can you give an idea how that success and
15 effectiveness is measured?

16 WITNESS TYSON: Yeah, I can. When we conduct
17 a test it is based on -- and we are evaluating a system
18 like that, it is based on a pressure in general below
19 the design limit load of the structure that it would be
20 installed in.

21 If we can keep that pressure below -- for
22 example, eighty percent of the -- our goal would be to
23 keep the pressure in our test in using these protection
24 systems at eighty percent, the design limit load of the
25 structure it will be installed in. That would be -- if

1 we can achieve that, that would be considered a
2 success.

3 CAPTAIN REKART: Okay. Of the various
4 inerting systems - and I shouldn't say inerting
5 system, I should say the remedial systems that are
6 available -- which system is or has been the most
7 reliable in every day operation?

8 WITNESS TYSON: You know -- sorry.

9 CAPTAIN REKART: Okay. I understand that
10 there are questions you can't answer from the
11 operational side of things, but they still have to be
12 addressed, and I hope you understand that.

13 MR. BALL: You ask and we'll answer.

14 CAPTAIN REKART: Okay, we will keep on going.
15 With regard to the remedial systems that we have
16 discussed, some questions regarding the role of the
17 crew.

18 As you are well aware, we don't have load
19 masters, we don't have mechanics and we don't have the
20 luxury anymore of flight engineers. So, all the
21 monitoring and all the work has to be done by the
22 captain and the first officer.

23 Who is responsible for monitoring the systems
24 that you develop for the different -- for the different
25 aircraft?

1 WITNESS TYSON: I am going to try to take a
2 shot at that. Again, I am not -- the foam doesn't
3 require anything in the installation, particularly in
4 the wings, as Dr. Ball mentioned, where it is installed
5 for the life of the aircraft.

6 I am really trying to -- there has been
7 another -- other questions that have asked a similar
8 thing, and I am really trying to recall how we intended
9 to interface the OBIG system to that cancelled program
10 I mentioned.

11 I believe there was a bit check done on
12 start-up of the airplane.

13 CAPTAIN REKART: Okay.

14 WITNESS TYSON: That would let the pilot know
15 the status of that system. Other than that, I don't
16 believe he had any -- it was a completely hands-off
17 system.

18 CAPTAIN REKART: Okay. Mr. Chairman, that
19 question is followed up with what indications to the
20 flight crew are available to show that the ullage space
21 in the tanks are in fact non-explosive, and are crew
22 actions required to either activate, re-set, trouble
23 shoot any of these systems.

24 Since there is no other members of the panel
25 that are able to address those, I was wondering if

1 there was a way that we could get the answers to that
2 for the record?

3 CHAIRMAN HALL: Well, I would -- I would
4 request that, and I do add that Mr. McSweeney has said
5 that he would include on the ARAC subcommittee working
6 group representatives from the military.

7 I know there are operational concerns, and
8 that might be the appropriate forum for them to be
9 addressed. But, if -- I will ask Dr. Ball and Mr.
10 Lauzze if you can take that information back and
11 provide something for the record we would certainly
12 appreciate it.

13 CAPTAIN REKART: Okay, the next question is
14 still a little bit more of a follow up on that, and it
15 is sort of a clarification question. It is hard to
16 follow the FAA, because they have been using the same
17 questions that I had all day.

18 The military uses a variant of the DC-9 as a
19 Med-evac airplane. The 707 and the DC-10 is tankers,
20 which are really airborne fuel tanks. The 737 and the
21 747 as V-aircraft, and also in other support roles.
22 They also have a very extensive craft fleet that they
23 call upon in time of emergencies.

24 Again, has the military considered or
25 actually attempted to employ inerting or any other

1 remediational technology in these activities? I
2 realize this is sort of close to the question that was
3 asked previously by Mr. Streeter, but I would like to
4 ask it again.

5 MR. LAUZZE: I really can't speak to that.

6 CAPTAIN REKART: Okay. That being true, the
7 statement was made earlier that these are systems. In
8 talking about the remedial system, a statement was made
9 earlier that these systems are -- these are systems
10 that the military already uses.

11 That isn't really a true statement. It is
12 true that you do use these remediation systems in
13 combat aircraft that are -- that are in a very
14 exclusive threat environment, but you don't use these
15 systems in any of the aircraft that we use in everyday
16 operation in the civilian world that I know of. Is
17 that a more correct statement, perhaps?

18 MR. BALL: Maybe if I try to explain how we
19 get involved. We are in a sense invited in at the
20 invitation of the Program Manager. Each aircraft
21 project or program has a manager, and theoretically
22 there would be a mission threat analysis done for each
23 aircraft.

24 If, in fact, in that mission threat analysis
25 it was revealed that that aircraft could come under

1 hostile fire, with the frequency of occurrence that it
2 became something that -- to seriously significantly
3 consider, then our community would be brought in and
4 our -- what would -- the mil standard 2069 that we had
5 would be imposed upon - and they would look into that.

6 These aircraft that you mentioned, I don't
7 know who the Program Managers were and I don't know
8 exactly how much they looked at that. Probably, it may
9 just have been a sense that they thought they were not
10 going to get shot at at the time.

11 CAPTAIN REKART: Okay, and these aircraft,
12 then, are certified in the normal method of
13 certification that we have been talking about the past
14 three days, with the assumption that the fuel tanks are
15 always containing an explosive mixture and that all
16 ignition sources must be removed from that environment,
17 is that correct?

18 I know the word "certify" doesn't exactly fit
19 what we are talking about right now, but it is the
20 closest word that I can come to in making that -- in
21 making that question.

22 MR. LAUZZE: We are way out of my field. One
23 thing I do know is that as part of the Joint
24 Aeronautical Commander Troop which is composed of the
25 three services, as well as representatives from NASA

1 and the FAA, they are working that FAA certification
2 issue as we speak.

3 In fact, there was a meeting last week, or
4 the week before last, where that was discussed. So, I
5 really have nothing to add other than we are working
6 the issue.

7 WITNESS MCSWEENEY: Mr. Chairman, or ALPA,
8 would you care if I add to that?

9 CHAIRMAN HALL: No, please proceed.

10 CAPTAIN REKART: I would be happy to add --
11 have you add to it, but they are nice questions for
12 you, and I think it will probably answer the question,
13 so if you would like to, go ahead, Tom.

14 WITNESS MCSWEENEY: Well, I think it is
15 really not a fair question for the military to really
16 be commenting on, on our certification. When we
17 certify an aircraft that is for use in military, that
18 it has got a civil derivative, that aircraft first and
19 foremost must meet the regulations.

20 There must be created a type design, or a
21 design of that aircraft that is in full and absolute
22 total compliance with the regulations. Many times,
23 though, what is delivered to the military is different
24 from that configuration, and what the military normally
25 gets from us is a statement of conformity of that

1 aircraft that says it complies with its civil type
2 certificate, except for these deviations.

3 Most of those deviations are in the area of
4 military unique equipment required for military unique
5 environments . That is basically the process we use.

6 CAPTAIN REKART: Okay. We will stay right
7 where we are. Yesterday Mr. Crow addressed the MEL.
8 How do you see these remedial possibilities that we
9 have discussed being addressed by the MEL, or getting
10 into the MEL.

11 Needless to say, to get into the MEL you have
12 to either be -- there are two areas that are addressed
13 by the MEL, things that are so fundamental to flying
14 that they have to be on the airplane. You have two
15 wings, therefore you need them both. The other side of
16 the equation is down at the other end, stuff that you
17 don't need like the -- perhaps soap and towels in the
18 lavatories.

19 But, in the middle of that we have the other
20 systems that through redundancy or through a secondary
21 system can't be inoperative under certain situations.
22 Can you address what you see as a necessity of these
23 remedial systems being involved in the MEL?

24 I am thinking about the poor guy that is
25 flying a DC-9 or an MD-80 across West Texas in the

1 middle of the summer and it is 108 outside and it is
2 105 on the tarmac and all of a sudden something goes
3 wrong. How is he going to get his airplane out of
4 there?

5 WITNESS MCSWEENEY: Yeah, I can certainly
6 address that. The basic premise behind any MEL item is
7 that the aircraft is in full compliance with the
8 regulations .

9 There is a dilemma that has to be, I think,
10 debated in the ARAC group, and that is that if we
11 decide -- whether we decide that we have an unsafe
12 condition and we need to correct it, or whether we want
13 to simply raise the safety bar higher, we define a new
14 level of safety.

15 If that level of safety can only be achieved
16 with that system on full time, then it is going to be
17 very difficult, if not impossible to conceive of an MEL
18 restriction, although there are some that are possible
19 that would allow you to achieve that same level of
20 safety with the system on.

21 Some of the possibilities are, you know,
22 changing the -- I mean, you would really have to change
23 the physical parameters within the fuel system. If
24 with that OBIGS -- let's say you had an OBIG system
25 that was suddenly inoperative.

1 If you are going to say that at some point --
2 if you have decided that there is a level of safety,
3 then it has to be achieved through the MEL process.
4 You cannot let that level of safety be violated.

5 CAPTAIN REKART: Do you think -- do you feel
6 that the present certification requirements of always
7 considering the explosive mixture and always removing
8 the ignition sources is adequate to allow the -- one of
9 these remedial sources to be -- or, remedial fixes to
10 be used, and then allow it to be inoperative?

11 WITNESS MCSWEENEY: I would just as soon not
12 bias the ARAC group. I think that is the issue that
13 they are supposed to be dealing with.

14 CAPTAIN REKART: Okay.

15 WITNESS MCSWEENEY: I would hazard to guess
16 that if I made a statement here, they would come back
17 and give me exactly what I asked for. I want them to
18 go through that thinking process.

19 CAPTAIN REKART: Okay, thank you. I have no
20 more questions, sir.

21 CHAIRMAN HALL: Thank you, Captain.
22 Honeywell, Inc.?

23 MR. THOMAS: Honeywell has no questions, Mr.
24 Chairman.

25 CHAIRMAN HALL: Crane Company Hydro-Aire?

1 MR. BOUSHIE: Crane has no questions, Mr.
2 Chairman.

3 CHAIRMAN HALL: Okay, do any of the parties
4 have any additional questions for this panel?

5 (No response.)

6 If not, does the Technical Panel have any
7 additional questions? Dr. Birky?

8 MR. BIRKY: I do; a couple of real short
9 questions, I think. In response to Mr. Streeter's
10 questions of Mr. Thomas, you referred to the triple
11 seven gaging system. My question -- as I understand
12 it, that gaging -- the gage sensor is in the bottom of
13 the tank, is that correct?

14 WITNESS THOMAS: Correct.

15 MR. BIRKY: In light of what we heard about
16 the build-up of the sulphur compounds, does that cause
17 you concern? Is it possible to move those sensors at
18 the top of the tank so they wouldn't be in the fuel?

19 WITNESS THOMAS: I would have to look at the
20 detailed design of the system and the wiring and
21 everything associated with it. Again, it is not -- it
22 is a pinging system, if you will. It is not a full-
23 time continuous frequency system.

24 If you -- if I understand from the testimony
25 of some day ago, you know, some -- the voltages

1 involved in this thing are part of the deposition of
2 the sulphur. So, we need to look at it. It is a good
3 question. We have added it on our things to go and
4 look at. But, I cannot answer you from here.

5 MR. BIRKY: Excuse me. From what I heard, I
6 wouldn't want to hang my hat on that the voltages
7 contributing to that without some chemical experimental
8 proof, would you?

9 WITNESS THOMAS: As I say, we need to go and
10 look at it.

11 MR. BIRKY: Okay.

12 WITNESS THOMAS: Absolutely.

13 MR. BIRKY: The other question I had relative
14 to that is, you indicated on the 747 the more recent
15 versions have shielded wires going to the center tank,
16 correct?

17 WITNESS THOMAS: I believe that is correct,
18 yes.

19 MR. BIRKY: Does Boeing have any efforts or
20 consideration on board to change that in the older
21 versions that don't have shielded wire?

22 WITNESS THOMAS: The FAA has proposed through
23 their NPRM action to do just that. We are in the
24 process of evaluating that in order to respond to the
25 FAA. So, the answer is yes, we are looking. But, it

1 is in order to respond to the FAA.

2 MR. BIRKY: Okay, thank you. That's all I
3 have.

4 CHAIRMAN HALL: Any other questions from the
5 Technical panel?

6 (No response.)

7 If not, Mr. Sweedler?

8 MR. SWEEDLER: Just one short question for
9 clarification. Could we put in perspective the various
10 size of these military airplanes that have some of
11 these systems on board; the C-131, the C-5A and the C-
12 17? How would they compare to civilian-sized aircraft?

13 MR. LAUZZE: Well, I believe relatively
14 speaking the C-5 would be in the same class as the 747.
15 The C-17 is a little bit smaller, but it is still
16 classified as a wide body. The C-130 obviously is much
17 smaller.

18 MR. SWEEDLER: Thank you. That is all I
19 have, Mr. Chairman.

20 CHAIRMAN HALL: Dr. Ellingstad?

21 DR. ELLINGSTAD: Thank you. Mr. Thomas,
22 recognizing, as you had indicated with respect to the
23 flight test, that both Safety Board and Boeing
24 engineers are wading through mountains of data on those
25 tests, do you feel that we have sufficient information

1 on the environment of the 747 center wing tank and the
2 surrounding components that might transfer heat to this
3 tank?

4 WITNESS THOMAS: I would say we have a very
5 good understanding of this at this point.

6 DR. ELLINGSTAD: You say that we do?

7 WITNESS THOMAS: I quite believe we do.

8 DR. ELLINGSTAD: So, you don't believe that
9 there are any additional flight tests, or on ground
10 tests that would be useful to develop a better
11 understanding?

12 WITNESS THOMAS: I think at this point we
13 have, as I said earlier, two computer models, one of
14 which is, quote/unquote, "a simple model" that allows
15 us to look at alternatives. We have a more
16 sophisticated model that is a closer representation of
17 the 747.

18 As we try and develop alternative ideas such
19 as some kind of cooling system, we think we may find
20 that there is a part of the system where we need more
21 detailed information where we would have to go run that
22 test, whether it is a ground test or a flight test.

23 DR. ELLINGSTAD: Because, as that --

24 WITNESS THOMAS: Part of that is just the
25 development process.

1 DR. ELLINGSTAD: Has any of that kind of
2 testing under operational environments been done on any
3 other aircraft in the Boeing fleet, other than this
4 747?

5 WITNESS THOMAS: To develop temperature data?

6 DR. ELLINGSTAD: Yes.

7 WITNESS THOMAS: We have -- in the course of
8 our investigation we took some very limited data off
9 the 737-700 because it was in flight test and we had
10 some small instrumentation set up on that airplane.

11 DR. ELLINGSTAD: Okay, so Boeing doesn't have
12 any --

13 WITNESS THOMAS: We do not have a lot of --

14 DR. ELLINGSTAD: -- immediate plans to do any
15 additional testing in this area?

16 WITNESS THOMAS: It would be a factor of what
17 system we came up with. If we -- again, if the process
18 we have described this morning of looking at what is
19 the requirements through the ARAC process, as we start
20 seeing what solution we are going to go to, it will
21 drive us to do the testing we need to do to develop the
22 system.

23 DR. ELLINGSTAD: Mr. McSweeney, do you feel
24 that there is sufficient empirical data describing the
25 operating environment of the center wing tank in the

1 747 and the things around it that transfer heat to the
2 tank?

3 WITNESS MCSWEENEY: That is my impression,
4 also, that there is sufficient data to give us a good
5 feel for what is going on in that tank.

6 DR. ELLINGSTAD: Dr. Shepherd, do you have a
7 view on this?

8 DR. SHEPHERD: Yes, I do. I believe that we
9 need to gather some additional information. Perhaps
10 there is other information that Boeing has access to,
11 but based on the information I know of from the flight
12 test, I think our knowledge is still incomplete.

13 DR. ELLINGSTAD: Thank you. Dr. Shepherd,
14 while we have you there -- and, again, taking the risk
15 of asking whether additional research is needed to an
16 academic, could you make a similar comment with respect
17 to the flammability characteristics of Jet-A? -- and
18 while you are on that topic, we may as well also treat
19 JP-5 .

20 DR. SHEPHERD: We started our evaluation of
21 Jet-A this summer, and our work has really been ongoing
22 only for the last five months, I would say. Our
23 evaluation has necessarily been limited because of that
24 short period of time.

25 We have been able to examine Jet-A, fresh

1 Jet-A from LAX, and we have done a limited examination
2 of Jet-A that was used in the flight test sponsored by
3 the NTSB in July.

4 I believe that it is necessary to get a much
5 more complete picture of this, particularly with regard
6 to the range of ignition energies that would be found
7 if you looked throughout the fuel supply in the world.

8 In addition, if we are going to propose using
9 JP-5, I believe that it is also necessary to get a much
10 more complete understanding of the ignition
11 characteristics of that fuel, also.

12 DR. ELLINGSTAD: Okay, thank you very much.

13 CHAIRMAN HALL: Dr. Loeb:

14 DR. LOEB: I don't have any questions, Mr.
15 Chairman. I do have a point that I would like to make.
16 A couple of points, I guess.

17 The first one that I believe we have made
18 significant progress in having our agreement that we
19 certainly need to look very strongly at means to reduce
20 or eliminate altogether the flammable mixtures in the
21 fuel tanks.

22 But, that brings into question the timing of
23 events, and I think we need to look at both short term
24 solutions and long term solutions, and our
25 recommendations of a year ago do go to that. Indeed,

1 there were short term -- recommendations for short term
2 solutions and recommendations for long term solutions.

3 I recognize that the parties have raised some
4 questions about the process by which we collected a lot
5 of the research and data, and what I want to make clear
6 is that as quickly as possible after this hearing is
7 adjourned, we are going to get all the parties together
8 and also the researchers with whom we have been working
9 to determine the answer to some of the questions that
10 Dr. Ellingstad just raised, and that is what more we
11 need to do to develop quickly short term solutions to
12 the problem while the process of developing the longer
13 term solutions go on.

14 so, you will be hearing from us quickly after
15 this hearing. We will be meeting just as soon as we
16 can.

17 CHAIRMAN HALL: I have a few clean-up
18 questions. I went over my notes last night to try and
19 be sure that all the things I thought should be briefly
20 discussed on the record were brought up, and there were
21 some things that we do not have any idea whether they
22 had anything to do with the TWA 800 accident, but there
23 was some things on the inspections that -- regarding
24 the O-rings and ruse on some of the components in the
25 tank.

1 Mr. Thomas, is there anything Boeing is doing
2 following up on that? I believe your folks were part
3 of those inspections. Were they?

4 MR. SWAIM: Yes, sir, the Boeing people were
5 with us every step of the way. We do it as a party
6 system, as you know. We found that there were a number
7 of rubber O-rings in the fuel tubing connections in the
8 accident airplane, and in other airplanes we looked at
9 that had a lot of cracking, and how that is checked
10 right now --

11 Well, let me ask Mr. Thomas, rather than
12 testifying myself. How are the integrity of the O-
13 rings checked in service, sir?

14 WITNESS THOMAS: It is checked in two ways.
15 One, the airplane flies daily. The fuel system, the
16 lines through the fuel system are all internal to the
17 fuel tanks, so if an O-ring starts to leak, if it is in
18 its own tank the fuel simply returns to the tank.

19 If it is in another tank in a cross-feed
20 line, then you will see some cross tank to tank
21 transfer of fuel, which will show up on the gaging
22 system and, as we heard yesterday, the pilots have the
23 option of writing -- or, will write a pi-rep, a pilot's
24 report, to make sure that maintenance is aware of that
25 tank to tank transfer, and they can go and investigate

1 it.

2 Also, when we functionally test the system
3 problems, for instance during an -- after an engine
4 change, we will check the -- what's the right word? --
5 functionality and integrity of the engine feed system.

6 MR. SWAIM: Would that include the O-rings in
7 the engine pylons?

8 WITNESS THOMAS: Yes.

9 MR. SWAIM: Okay, but those O-rings in the
10 engine pylons are outside of the fuel tank?

11 WITNESS THOMAS: Yes, and -- yeah, and as we
12 discussed yesterday afternoon, an O-ring leaking in the
13 pylon will become very obvious very quickly.

14 MR. SWAIM: Because that fuel will go where?

15 WITNESS THOMAS: It will drain -- it will
16 drain down the pylon through a drain line to the bottom
17 of the cell and overboard.

18 MR. SWAIM: Okay. Is the opinion of yourself
19 or the Boeing Company that leakage within the fuel
20 tanks is acceptable in those types of cases?

21 WITNESS THOMAS: Minor leakage inside the
22 fuel tank that doesn't cause major pilot concern or a
23 tank to tank transfer is acceptable. Obviously, the
24 pilots themselves have that discretionary option of
25 saying, "I really don't like what is happening; it is

1 causing me to do too many corrective re-balances of the
2 airplane."

3 As we described yesterday, a fuel leak in the
4 cell -- or, rather in the strut itself, would be noted
5 by the maintenance people and appropriate action taken.

6 MR. SWAIM: Okay. We know that in some cases
7 fuel hoses and other rubberized components have a set
8 life for the rubber, especially for the package life in
9 that -- I am thinking of other airplanes, especially
10 flexible braided fuel lines -- but, in the case of a
11 transport airplane such as this, what is the life that
12 you expect out of an O-ring, or the whole series of O-
13 rings? Is there a set life?

14 CHAIRMAN HALL: Mr. Swaim, I don't want to
15 cut you off.

16 MR. SWAIM: Okay.

17 CHAIRMAN HALL: But, I really -- the only
18 question I wanted to know is that you are aware of it
19 and are you looking at it.

20 MR. SWAIM: Very good.

21 WITNESS THOMAS: The short answer is yes, and
22 yes.

23 CHAIRMAN HALL: Okay. You know, a leak is a
24 leak, and I assume even though it is acceptable for a
25 short period of time under some situations, it wouldn't

1 be for a long period.

2 You mentioned, Mr. Thomas, that you -- that
3 in some of your later 747's that some of the low
4 powered wiring was shielded?

5 WITNESS THOMAS: Correct.

6 CHAIRMAN HALL: Could you explain the
7 difference to me between the later model 747's and the
8 earlier in regard to that, the shielding?

9 WITNESS THOMAS: As we described yesterday, I
10 believe it was, there is two -- the reason for
11 shielding is low energy EMI, or coupling between other
12 wiring.

13 We have shielding on the Honeywell gaging
14 system because when we introduced -- I forget what
15 particular feature it was, onto the airplane, it
16 introduced some low level noise.

17 On the 747-400's and 757-67 airplanes, the
18 gaging system works on a slightly different principal.
19 The Honeywell system works on sending a -- basically, a
20 high frequency signal to the probes, and you can filter
21 out noise on that high frequency by -- just like you
22 tune a radio. You can have filtering on the system.

23 The newer systems in effect pulse the probes,
24 and there is a lot of information on that pulse. We
25 look for resistance, we look for capacitance, we -- in

1 effect, it is almost to the point where we can tell the
2 crew where a break in the wire is by this pulsing
3 technique, a measurement technique.

4 so, that is very open to noise. So, it is
5 very -- for performance reasons, we have to shield that
6 wiring.

7 CHAIRMAN HALL: That is not done for any
8 safety reasons?

9 WITNESS THOMAS: No, sir.

10 CHAIRMAN HALL: Now, given the information
11 that TWA 800 and looking back at the Philippine
12 accident in retrospect, is that anything that you all
13 are going to look at as to whether those wirings should
14 be shielded and whether the low voltage and high
15 voltage -- is that the correct terminology? -- should
16 run together?

17 WITNESS THOMAS: Yes, sir. As I said in a
18 question that somebody else posed just now, the NTSB --
19 excuse me, the FAA have proposed doing that by their
20 NPRM, and we are going to address the NPRM.

21 CHAIRMAN HALL: Mr. McSweeney, could you
22 maybe just briefly give us where the -- where you are
23 in regard to the -- or, the FAA is -- in regard with
24 the service bulletins that Mr. Thomas went over, and
25 how long you would anticipate once those service

1 bulletins were put out that it would take to put them
2 in effect?

3 WITNESS MCSWEENEY: We are working with
4 Boeing in understanding those service bulletins as they
5 are being drafted. Our intent is to be prepared when
6 the final service bulletin is issued to immediately
7 issue the airworthiness action.

8 CHAIRMAN HALL: Mr. Thomas, you mentioned
9 that -- earlier, that there were two types of AD's, or
10 one of these on colored paper and one on the white
11 paper, and one was an alert? I believe TWA said they
12 treated an alert as an AD.

13 When you issue the service bulletin will --
14 do you know at this point in time whether that will be
15 an alert, or just a -- I mean, a service bulletin --
16 but, it would just be an alert?

17 WITNESS THOMAS: This is for which service
18 bulletin, sir?

19 CHAIRMAN HALL: Any of the ones you are
20 putting out that you just went over.

21 (Pause.)

22 WITNESS THOMAS: I do not believe any of them
23 are alert at this point, although the fuel pump conduit
24 service bulletin was an alert service bulletin followed
25 up with an AD.

1 CHAIRMAN HALL: So, in other words, prompt
2 response by the FAA if they think those need to be AD's
3 would be needed for them to -- we see the action in the
4 industry? Mr. McSweeney?

5 WITNESS MCSWEENEY: Yeah, I just might want
6 to add that we really make a determination and look at
7 service bulletins on a regular basis, and we --
8 historically, even AD service bulletins that weren't
9 alert service bulletins, and at other times we have
10 AD'd the alert service bulletin, but we have disagreed
11 with the timing in it and, so, we have come out with
12 our own timing in the AD.

13 so, it is -- we look at them independent of
14 what they recommend.

15 CHAIRMAN HALL: Very good. I would like to
16 now go and call on the panel and see if you have any
17 closing comments. This is our final panel. Anything
18 else that you think that the National Transportation
19 Safety Board should be exploring or looking at, or any
20 other thoughts that you have in regard to this whole
21 matter that you would like to put on the public record?

22 Dr. Shepherd?

23 DR. SHEPHERD: Yes, sir, thank you. I would
24 just like to second Dr. Loeb's comments. We have heard
25 a lot of discussion yesterday and today about fuel

1 flammability reduction techniques. It is gratifying to
2 hear that reduction of fuel temperature is included in
3 that.

4 However, the bureaucratic process that has
5 been outlined to evaluate those techniques does not
6 promise to be short, and I think it is important that
7 we consider simple interim modifications to the --
8 either operation or hardware in the current fleet, the
9 commercial transports.

10 I believe in this regard anything we can do
11 to reduce the fuel and the ullage temperature in the
12 center wing tank should be carefully considered. Thank
13 you .

14 CHAIRMAN HALL: Mr. McSweeney, we appreciate
15 your twenty-three years of public service at the
16 Federal Aviation Administration. Is there anything
17 that you would like to add?

18 WITNESS MCSWEENEY: I would just, I guess,
19 like to summarize in a few short words that -- starting
20 first with our goal. Immediately after the tragic
21 accident, today and in the future our goal will always
22 be the same, to never again have a tragic accident like
23 TWA 800.

24 I want to emphasize that we are looking at
25 the full triangle. We are looking at fuel, we are

1 looking at the oxidizer and we are looking at the
2 ignition spark.

3 We have, I believe, taken some action on
4 short term solutions. The AD on wing fuel pump
5 conduits is, in our mind, a possible scenario for this
6 accident that we have effectively dealt with to take it
7 out of any realm of possibility at this point on
8 happening on any other aircraft.

9 Our NPRM AD on the fuel quantity indicating
10 system deals with three failure modes that possibly
11 could be considered as scenarios in this accident. So,
12 I think those are short term actions that we have
13 taken.

14 I appreciate the opportunity to make those
15 comments.

16 CHAIRMAN HALL: Mr. Thomas, thirty-one years
17 at the Boeing Company, a Chief Engineer and now a
18 veteran of four panels at this public hearing. I think
19 you deserve a raise.

20 (Laughter.)

21 I noticed on your experience that you worked
22 as a designer on the Concord fuel system.

23 WITNESS THOMAS: Yes.

24 CHAIRMAN HALL: You know, in your closing
25 comments, is there anything of that system that is done

1 that would be -- we could learn from?

2 WITNESS THOMAS: On that airplane, it is --
3 that is an interesting airplane, because the very act
4 of going supersonic raises its temperature, and in
5 reality that airplane goes from lean through the
6 flammability region out into rich every flight every
7 day.

8 It is obviously designed to exactly the same
9 standards that we use. It is a very much more
10 complicated fuel system. That is probably why I am
11 still in fuel systems. If you can do the Concord one,
12 you can -- the rest are relatively easy until you get
13 to something like the B-2.

14 First of all, I would like to thank the Board
15 for the opportunity. It has been a long, hard week. I
16 have learned a huge amount. We were talking about it
17 at dinner time last night, and the young panelist with
18 me on the electrical system made a comment that it was
19 such a sobering reminder of what safety really means.

20 We talk about safety daily, but to come to
21 this hearing and really talk about it in terms of this
22 accident is a very powerful influence on our lives.
23 Jerry was saying we really need to figure out how we
24 take a ten-minute synopsis of this and make it
25 available to our employees to get the message over, and

1 tell them over and over again.

2 I think the hearings has given the American
3 people an opportunity to see everybody who is involved
4 in this and to hear everybody and the concerns that we
5 all have about safety. I think this is very important.

6 Lastly, I would like to say in a sense we may
7 not ever know what occurred on TWA 800, and in some
8 respects had we have known if it was an arc-external
9 threat and we knew about it six weeks after the
10 accident, we wouldn't be here holding any of these
11 discussions on reducing flammability.

12 What we really have is an accident where we
13 may not know the cause, but it has forced us --
14 everybody in the industry -- to sit back and really
15 evaluate all our fundamental premises for designing
16 airplanes, and in the long run, even without knowing
17 the cause of TWA 800, the end result will be much safer
18 airplanes.

19 It is a great opportunity to go forward and
20 do that.

21 CHAIRMAN HALL: Thank you very much. Well,
22 Captain Green, as a pilot in your profession, as those
23 of us in the traveling public look in that cockpit
24 every time we get on the plane and trust our safety to
25 you all, I appreciate very much your -- as well, of

1 course, as the mechanics and flight attendants and all
2 the others in the industry.

3 But, the most visible thing to the individual
4 are the pilots, and they are well respected and highly
5 regarded, and we are pleased to have you participate.
6 Do you have any closing comments?

7 CAPTAIN GREEN: I think, Mr. Chairman, there
8 are two things relative to the panel that I would like
9 to mention. One is just to reiterate that we are
10 dealing with a different ignition source than the
11 military deals with, and the importance of identifying
12 that ignition source and the susceptibility that it
13 presents remains paramount to us because of the
14 potential threat and other matters.

15 Secondly, this hearing has made me even more
16 aware, tremendously aware of a number of bodies of
17 knowledge that are actively developing very, very
18 rapidly, beginning with the work that the Safety Board
19 has done in flammability and in aircraft wiring, the
20 work that Boeing has done and the work that the FAA has
21 done and the flight tests that the Safety Board
22 conducted.

23 The thing I would like to emphasize again is
24 the need for timely and effective and thorough
25 communications between all of these working groups as

1 quickly as we can as we run up to these ARAC processes
2 and so forth.

3 It has been a very, very long and interesting
4 experience this week. We would really like to thank
5 the Board for the opportunity to be on the panel and
6 participate in the investigation.

7 CHAIRMAN HALL: Thank you very much, Captain.

8 Mr. Lauzze, I want to thank just you and Dr.
9 Ball and Mr. Tyson all at the same time for your
10 contributions on the military side to aviation safety,
11 and give you three gentlemen an opportunity to make any
12 comments that you would like to make.

13 MR. LAUZZE: Thank you very much, Mr.
14 Chairman. From my position, one thing I would like to
15 walk away with is a new spirit of cooperation, I think,
16 among the different agencies that are involved.

17 The Army and the Navy and the Air Force have
18 formed a committee that Dr. Ball mentioned yesterday,
19 the Joint Technical Coordinating Group on Aircraft
20 Survivability. We share planning, we share resources,
21 we share data.

22 We have a couple of years ago signed an MOU
23 with the FAA Atlantic City Tech Center to also share
24 data. I would like to see that continue and expand,
25 and maybe even share some more resources in the

1 planning exercise, as well.

2 We, for example in the military community,
3 have been trying for over twenty years to get some
4 flight test data, and the data you collected just
5 recently on the 747 is going to help us immensely. So,
6 I would like to offer our facilities and our support
7 and our cooperation.

8 Thank you, sir.

9 CHAIRMAN HALL: Thank you. Dr. Ball?

10 MR. BALL: Just one final comment, Mr.
11 Chairman. I would like to thank you for giving us the
12 opportunity to participate in this very important
13 public hearing.

14 You have given us a chance to show the public
15 what we can do, and we hope that what we have presented
16 here will be helpful to you in coming to your final
17 solution.

18 CHAIRMAN HALL: And Mr. Tyson?

19 WITNESS TYSON: I would just like to second
20 Ralph's offer for cooperation both in our facilities
21 and exchange of data, and thank you very much for
22 having the opportunity to be here.

23 CHAIRMAN HALL: Thank you. Before I move to
24 my closing statement, I would like to go down the
25 parties and see if any of the -- I would like to

1 acknowledge each of the parties, and if any of the
2 parties have closing comments they would like to make.

3 We will follow the usual order and begin with
4 Crane Company Hydro-Aire. Mr. Russell (sic), thank you
5 for your presence and attendance at this hearing.

6 MR. BOUSHIE: Thank you, Mr. Chairman. It is
7 somewhat redundant as we go through the panel and the
8 witnesses and listen to everyone's comments, because I
9 think that it exemplifies basically all of our
10 feelings.

11 I would only like to say that I share in lots
12 of the spirit that has been expressed here, and I think
13 we will all go away with a different attitude and a
14 different perspective toward air safety.

15 Thank you very much.

16 CHAIRMAN HALL: Thank you. The International
17 Association of Machinists and Aerospace Workers? Mr.
18 Liddell?

19 MR. LIDDELL: Thank you, Mr. Chairman. We
20 would like to take this opportunity to thank you for
21 our participation in these hearings and the
22 investigation, and to also state that we stand back to
23 further assist you in this effort.

24 CHAIRMAN HALL: I appreciate your presence.
25 While the public may see the pilot, I am sure the pilot

1 sees the mechanic and is counting on his good work to
2 keep the plane safe, and you represent a very important
3 group of people that both work on the planes and design
4 and build them.

5 Trans World Airlines, Inc.? Captain Young,
6 thank you very much for TWA's participation in this
7 hearing.

8 CAPTAIN YOUNG: Thank you very much, Mr.
9 Chairman. I would like to say on behalf of Trans World
10 Airlines we appreciate the ability to participate in
11 the hearing, and we certainly will continue to devote
12 our utmost support for the continuing work of the
13 Board.

14 Thank you very much.

15 CHAIRMAN HALL: Thank you. The Federal
16 Aviation Administration? Mr. Streeter, thank you, and
17 thank you for bringing Mr. Dormer to sit at the table.

18 MR. STREETER: Certainly, sir. He needs to
19 keep an eye on me. Other than that, the FAA looks
20 forward to continued cooperation and participation with
21 all the parties in the investigation.

22 CHAIRMAN HALL: Thank you, sir. Boeing
23 Commercial Airplane Group? Mr. Rodrigues?

24 MR. RODRIGUES: Thank you, Mr. Chairman. I
25 think Mr. Thomas pretty well expressed Boeing's

1 opinion. We have thoroughly enjoyed all of the
2 exchange of information that we have received here this
3 week, and we will just continue on two paths, the first
4 being continue to try and find what the cause is.

5 It has been pretty frustrating for us who
6 have been putting in long hours for many months and
7 still not have a cause. So, we will continue there, of
8 course.

9 As Mr. Thomas said, we are doing many other
10 things, and we will pursue that. Thanks .

11 CHAIRMAN HALL: Well, your company is a
12 leader in the aviation industry and I think all
13 Americans are proud of the 200,000 employees. It is
14 one of the flagship companies in our country, and we
15 appreciate the commitment you have made to help us in
16 these matters that have been discussed here today.

17 Captain Rekart with the Air Line Pilots
18 Association?

19 CAPTAIN REKART: Well, sir, we have all been
20 here for seventeen months so far, and we have covered a
21 lot of ground, and we are looking forward to being a
22 part of the continuing investigation and taking it to
23 the conclusion, sir.

24 CHAIRMAN HALL: Thank you very much.
25 Honeywell, Inc., and Mr. Thomas?

1 MR. THOMAS: I thank you, Mr. Chairman, for
2 the opportunity to participate in this hearing, and
3 Honeywell will be available to assist in any way
4 possible in the future.

5 CHAIRMAN HALL: Well, thank you. Well, with
6 the last witness having been heard, we have concluded
7 this phase of the Safety Board's investigation into the
8 crash of TWA Flight 800.

9 In closing, I want to sincerely express my
10 deep appreciation to all the participants in this
11 hearing. I believe we have had a very productive week.

12 As I said when we began, the National
13 Transportation Safety Board serves as the eyes and ears
14 of the American people at an accident site, and these
15 hearings are an exercise in accountability.

16 In holding this hearing seventeen months
17 after the TWA 800 tragedy, we were seeking to explain
18 to the American public just what we -- where we are in
19 the investigation and describe in some detail what has
20 been done to date not only by the National
21 Transportation Safety Board and its contractors, but
22 also by the parties, by industry and the federal
23 regulatory authorities.

24 We have presented all of the factual
25 information available at this time, and I want to take

1 this opportunity to thank the technical staff, some of
2 whom are represented to my right, for the work and
3 commitment they have brought to this investigation.

4 The technical expertise of this Board is
5 something the American people can be proud of. I am
6 proud to be associated with these men and women and
7 have an opportunity to serve as their spokesperson.

8 I hope that we have been successful in
9 demonstrating the breadth and depth of the effort to
10 determine exactly what happened to TWA 800. We have
11 sought to take a careful, objective look at all
12 conceivable ideas and theories and have called on a
13 wide array of experts from around the world to assist
14 us i this endeavor.

15 We are by no means finished. Our work will
16 continue, and we will spare no effort to determine the
17 cause of the crash of TWA 800. I am confident that in
18 the process we will learn a great deal more that will
19 help make our air transportation system even safer.

20 This hearing also represents what I believe
21 is a milestone in forging a broad base systematic
22 approach to dealing with the dangerous vapors that can
23 accumulate in fuel tanks. The acceptance of a two-
24 track approach to this problem is an important safety
25 advance for the traveling public.

1 As testimony this week has shown, dangerous
2 conditions in fuel tanks occur more commonly than had
3 been believed, and when the tank is heated, the amount
4 of energy needed to ignite the vapors drops
5 significantly.

6 I welcome the FAA's willingness to take
7 another look and re-evaluate the recommendations on
8 fuel/air mixture volatility made by the NTSB one year
9 ago.

10 I also welcome the Boeing Corporation's
11 expressed openness to examine additional ways of
12 dealing with the dangers of fuel tank vapors suggested
13 by the Safety Board. I hope this hearing has
14 demonstrated the extensive work that has already been
15 done by the Boeing and the FAA in this investigation.

16 The NTSB has long advocated a two-track
17 approach to the fuel tank problem, pointed up by the
18 crash of TWA 800. This position is derived in part
19 from the lessons learned over the years. Thirty years
20 of accident investigation experience has taught us the
21 value of not relying on a single approach to resolving
22 a serious safety problem.

23 We applaud the work that has been done to
24 remove all potential ignition sources for fuel tank
25 explosions, but as has been stated frequently at this

1 meeting, we can never be sure that all possible
2 ignition sources can be eliminated. Therefore, the
3 Safety Board strongly believes that additional measures
4 to stabilize fuel tank vapors are necessary and
5 prudent.

6 The Board certainly recognizes the need to
7 proceed carefully in making changes to systems that on
8 a whole have performed safely and reliably for extended
9 periods of time.

10 Let me say again, the 747 aircraft has a very
11 safe record, and we have the safest aviation system in
12 this country of the whole world, and that is as a
13 result of a lot of work that is done -- good work that
14 is done by the individuals that design the aircraft,
15 manufacture the aircraft, people that maintain the
16 aircraft, the people that fly the aircraft and the
17 government regulators that try to oversee those
18 processes. It is a record all Americans can be proud
19 Of, and I think that is one of the reasons we see the
20 dramatic growth in aviation today in our country.

21 We do want to be sure that the fixes that are
22 made are the right ones and that no new problems are
23 introduced, but these concerns should not immobilize
24 government and industry and inhibit us from acting
25 vigorously and with dispatch when, as in the case of

1 the crash of TWA 800, a problem is uncovered.

2 It is only through prompt, effective and
3 sustained action that the aviation industry and the
4 government's regulatory system can retain the
5 confidence of the American people.

6 Let me emphasize that this investigation will
7 remain open to receive at any time new and pertinent
8 information concerning the issues discussed this week.
9 The Board may at its discretion again reopen the
10 hearing in order that such information may be made part
11 of the public record.

12 The Board welcomes any information or
13 recommendations regarding this accident from the
14 parties or the public that may assist us in our efforts
15 to insure the safe operation of commercial aircraft.
16 Any such recommendation should be sent to the National
17 Transportation Safety Board, Washington, D.C. 20594,
18 to Mr. Al Dickinson's attention.

19 Normally, submissions should be received
20 thirty days after the receipt of the transcript of this
21 hearing. However, since there are still investigation
22 activities open in this case, Mr. Dickinson will notify
23 the parties when the final submissions are due.

24 All the evidence developed in this
25 investigation and hearing, and all recommendations

1 received within the specified time will be presented
2 and evaluated in the final report on TWA 800 in which
3 the Board's determination of the probable cause will be
4 stated.

5 The record of the investigation, including
6 the transcript of the hearing and all exhibits entered
7 into the record, will become part of the Safety Board's
8 public docket on this accident, and will be available
9 for inspection at the Board's Washington office.
10 Anyone wishing to purchase the transcript, including
11 the parties to the investigation, may contact the Court
12 Reporter directly.

13 On behalf of the National Transportation
14 Safety Board, I want to thank again the parties for
15 their cooperation, not only during this proceeding, but
16 also throughout the entire investigation of this
17 accident.

18 Also, I would like to express sincere
19 appreciation to all those individuals, groups,
20 corporations and agencies who have provided their
21 talents so willingly through this hearing.
22 Specifically, the members of the National
23 Transportation Safety Board administrative staff who
24 assisted through this hearing.

25 In closing, I want to thank the family

1 members who have been with us this week. It is good
2 that so many of you all were able to attend. I know
3 that in many ways this has been a very difficult week
4 for you and I hope, though, that what you have seen of
5 the work underway to solve TWA 800 and the effort by
6 everyone here to learn how to prevent such tragedies in
7 the future, that this may give you some degree of
8 comfort and will serve as a legacy to those who lost
9 their lives on that flight.

10 I have received a very gracious letter from
11 the families thanking the Safety Board for their hard
12 work. I am going to make that letter available for all
13 of my technical staff and the others that have worked
14 so hard on this investigation, as well as the parties,
15 and I will submit that letter for the hearing record.

16 Thank you very much again, and I want to
17 assure the families that, of course, we will continue
18 to stay in close touch with you as the investigation
19 proceeds and, as we have in the past, share all
20 information with you.

21 I finally want to thank C-Span for covering
22 this hearing gavel to gavel. There has been so much
23 attention both in this country and around this world on
24 this accident, I am glad that the American people had
25 an opportunity to view these proceedings, and I want to

1 again thank C-Span for that opportunity, being here and
2 being able to show to the nation one of our hearings
3 gavel to gavel.

4 Therefore, I will now as Chairman of this
5 hearing declare this hearing to be in recess
6 indefinitely.

7 (Whereupon, at 12:30 p.m. the hearing was
8 adjourned until further notice.)

9 - - -

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25